IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

FILED: JULY 23, 2008
08CV4192
JUDGE GUZMAN
MAGISTRATE JUDGE ASHMAN
EDA

PRECI-DIP SA,
a Swiss Corporation,

Plaintiff,

v.

TRI-STAR ELECTRONICS INTERNATIONAL, INC.,
a California Corporation,

Defendant.

Case No. _____

JURY DEMANDED

COMPLAINT

Plaintiff Preci-Dip, SA ("Preci-Dip") files this Complaint against defendant Tri-Star Electronics International, Inc. ("Tri-Star"), and alleges as follows:

PARTIES

1. Plaintiff Preci-Dip is a corporation organized under the laws of Switzerland with a principal place of business at Rue St Maurice 34, CH-2800 Delémont, Switzerland.

2. Preci-Dip is a world leader in the design, manufacture and sale of cutting-edge interconnect components, such as its patented interconnect component that is the subject of this action.

3. Upon information and belief, Defendant Tri-Star is a corporation organized under the laws of California, with a principal place of business at 2201 Rosecrans Ave., El Segundo, California, 90245.

4. Tri-Star is a competitor of Preci-Dip, and has alleged, through, among other things, a complaint and communications with Preci-Dip's customers, that Preci-Dip's patented interconnect component infringes a patent alleged to be owned by Tri-Star.

NATURE OF THE ACTION

5. This is a declaratory judgment action that seeks a declaration that U.S. Patent No. 6,250,974 (the "'974 Patent"), which issued June 26, 2001 to Leslie Laszlo Kerek and is assigned on its face to Tri-Star, is invalid, void, unenforceable and not infringed by Preci-Dip. A copy of the '974 Patent is attached as Exhibit A. This Complaint also states claims based on Tri-Star's unfair competition in violation of 15 U.S.C. § 1125(a)(1)(B), 815 ILCS 510/1, *et seq.*, 815 ILCS 505/1, *et seq.* and Illinois common law, as well as Tri-Star's tortious interference with contractual and future business relationships with Preci-Dip.

JURISDICTION AND VENUE

6. This Court has subject matter jurisdiction under one or more of the following statutes: 28 U.S.C. § 1331 (federal question), 28 U.S.C. § 1332 (diversity of citizenship), 28 U.S.C. § 1338 (patents; unfair competition), 28 U.S.C. § 2201 (declaratory judgment), and 28 U.S.C. § 1367 (supplemental jurisdiction).

7. Tri-Star is subject to personal jurisdiction in the Northern District of Illinois based upon its contacts within the State of Illinois and within this District, including, but not limited to, its conducting of business within this District, the presence of significant customers within this District, and the presence of at least one significant Tri-Star distributor within this District. A substantial part of the events giving rise to the claims set forth herein occurred within this District.

8. Venue is proper under 28 U.S.C. § 1391 (b) and (c).

BACKGROUND AND FACTS RELATED TO THIS ACTION

9. Preci-Dip manufactures and sells a MIL (Military) contact with reversed clip under military specification MIL C-39029 (the "Preci-Dip Reversed Clip Contact"). The Preci-Dip Reversed Clip Contact comprises three main parts: a contact body, a reversed clip, and a hood.

10. The Preci-Dip Reversed Clip Contact is covered by one or more claims of Preci-Dip's U.S. Patent No. 6,264,508 (the "'508 Patent"). A copy of the '508 Patent is attached as Exhibit B.

11. Preci-Dip sells the Preci-Dip Reversed Clip Contact through its distributors and to various customers, some of which are located in the United States and within this District.

12. The '974 Patent, alleged to be owned by Tri-Star, is directed to a hoodless electrical socket contact, and is appropriately entitled, "Hoodless Electrical Socket Contact." (See Exhibit A).

13. Upon information and belief, Tri-Star directly, or through its agents, distributors, and affiliates, sells and distributes various hooded electrical socket contacts throughout the United States, including within this District, but does not sell any "hoodless" socket contact covered by the claims of its '974 patent.

14. On January 25, 2006, Tri-Star sent a letter to Preci-Dip indicating, among other things, that Tri-Star believed "Preci-Dip may be in violation of Tri-Star's reverse clip contact design." (Exhibit C).

15. Preci-Dip responded to Tri-Star's letter on April 26, 2006, stating that after conducting its investigation, Preci-Dip concluded that it does not infringe any valid, enforceable claim of Tri-Star's patent. (Exhibit D).

16. When Preci-Dip did not receive any response to its April 26, 2006 letter, Preci-Dip proceeded with its business, investing substantial money, time and effort in expanding its products and sales, all while operating under the assumption that Tri-star agreed with its conclusion of noninfringement. However, nineteen (19) months later, on November 14, 2007, Tri-Star sent another letter, once again accusing Preci-Dip's Reversed Clip contact of "violating [Tri-Star's] patent filings" without any explanation of the merits of its claim. (Exhibit E).

17. On or about December 4, 2007, Preci-Dip responded seeking details from Tri-Star regarding the merits of its claim.

18. Preci-Dip never received a response to its December 4, 2007 letter.

19. Several months later, Preci-Dip learned from a customer, that Tri-Star was circulating a complaint it had apparently filed against Preci-Dip in the Central District of California (the "Tri-Star Complaint"), accusing Preci-Dip's Reversed Clip contact of, among other things, infringing the '974 Patent. The Tri-Star complaint is captioned as Civil Action 2:08-cv-04226-GAF-AJW in the Central District of California. Tri-Star has never properly served this complaint on Preci-Dip.

20. Contemporaneously with the filing of its complaint, Tri-Star sent a letter to numerous customers and distributors of Preci-Dip informing them of Tri-Star's complaint and its claims that Preci-Dip's Reversed Clip Contact infringes the '974 patent. A copy of one of the customer letters is attached as Exhibit F.

21. Thereafter, Tri-Star personnel intentionally called some of these same Preci-Dip customers to, among other things, further threaten and coerce them to not buy Preci-Dip's Reversed Clip Contact.

22. At least one Preci-Dip customer, who also distributes Tri-Star products, was told by Tri-Star that if it continued to carry Preci-Dip products, Tri-star would terminate its relationship with the customer.

23. On information and belief, Tri-Star has a nonexclusive agreement with its distributors/customers that unlawfully prohibits these distributors from handling competitive products.

CAUSES OF ACTION

COUNT I

Declaration of Noninfringement

24. Preci-Dip realleges and incorporates herein the preceding paragraphs 1 – 23 of this Complaint.

25. As a result of Tri-Star's conduct, Preci-Dip has a reasonable apprehension that Tri-Star plans to file a legitimate suit against Preci-Dip for infringement of the '974 Patent and that such suit is imminent. Accordingly, there exists an actual, justiciable and legal controversy between Tri-Star and Preci-Dip regarding Preci-Dip's alleged infringement of the '974 Patent.

26. Preci-Dip has not infringed, is not now infringing, and has not contributorily infringed or induced infringement of any valid claims of the '974 Patent.

27. Preci-Dip is, therefore, entitled to a judicial determination and declaration that its products do not infringe, and have not infringed, any valid claim of the '974 Patent, and that Preci-Dip has not committed any act of infringement of the '974 Patent with respect to products made or sold by Preci-Dip since issuance of the '974 Patent.

COUNT II

Declaration of Invalidity and Unenforceability

28. Preci-Dip realleges and incorporates herein the preceding paragraphs 1 – 27 of this Complaint.

29. Preci-Dip alleges, on information and belief, that the '974 Patent is invalid, unenforceable or void for failure to comply with one or more of the requirements of the Patent Laws of the United States, including 35 U.S.C. §§ 102, 103 and 112.

30. The '974 is unenforceable because Tri-Star has misused its patent and has unlawfully attempted to extend the scope of its alleged patent rights under the '974 Patent.

31. Preci-Dip is, therefore, entitled to a judgment declaring that the '974 Patent is invalid, void and unenforceable.

COUNT III

Federal Unfair Competition (15 U.S.C. § 1125(a)(1)(B))

32. Preci-Dip realleges and incorporates herein the preceding paragraphs 1 – 31 of this Complaint.

33. As set forth above, Tri-Star has embarked on a campaign targeted at smearing the goodwill associated with Preci-Dip's name and Reversed Clip contact product and threatening Preci-Dip's own customers with legal proceedings for buying or selling the Preci-Dip product.

34. In particular, on information and belief, Tri-Star has systematically and continually used in commerce false and misleading representations of fact such as the false representation that the Preci-Dip Reversed Clip Contact did not meet the military specifications for which it was designed. Such statements misrepresent the characteristics and qualities of Preci-Dip's goods.

35. In addition, on information and belief, Tri-Star has embarked in bad faith on a campaign to harass, illegally threaten and coerce Preci-Dip's own customers to stop selling the Preci-Dip Reversed Clip Contacts.

36. Tri-Star's conduct is causing, and is likely to continue to cause in the future, damage to Preci-Dip, in violation of Section 43 of the Lanham Act, 15 U.S.C. § 1125(a)(1).

37. Tri-Star's unauthorized and tortious conduct also has deprived and will continue to deprive Preci-Dip of the ability to control the consumer perception of its goods, placing the valuable reputation and goodwill of Preci-Dip in the hands of Tri-Star, over whom Preci-Dip has no control.

38. Tri-Star's misrepresentations, bad-faith threats and other conduct, particularly toward Preci-Dip's current and potential customers, renders this case exceptional under 15 U.S.C. § 1117(a).

39. As a result of Defendants' aforesaid conduct, Preci-Dip has suffered substantial damage and irreparable harm constituting an injury for which Preci-Dip has no adequate remedy at law. Unless this Court enjoins Tri-Star's conduct, Preci-Dip will continue to suffer irreparable harm.

COUNT IV

Violation of the Illinois Deceptive Trade Practices Act (815 ILCS 510/1 et seq.)

40. Preci-Dip realleges and incorporates herein the preceding paragraphs 1 – 39 of this Complaint.

41. Tri-Star's actions complained of herein constitute deceptive trade practices in violation of 815 ILCS 510/2(a). As alleged above, in its conversations with Preci-Dip's current

and potential customers, Tri-Star deliberately disparaged Preci-Dip's goods and business by false and misleading representations of fact.

42. As a result of Tri-Star's willful and malicious conduct, Preci-Dip is likely to suffer, and has in fact already suffered, substantial damage and irreparable harm for which it has no adequate remedy at law. Unless this Court enjoins Tri-Star's conduct, Preci-Dip will continue to suffer irreparable harm.

COUNT V

Violation of Illinois Consumer Fraud and Deceptive Business Practices Act (815 ILCS 505/2)

43. Preci-Dip realleges and incorporates herein the preceding paragraphs 1 – 42 of this Complaint.

44. Tri-Star's actions complained of herein constitute unfair methods of competition and unfair or deceptive acts or practices in violation of 815 ILCS 505/2. In its conversations with Preci-Dip's current and potential customers, Tri-Star employed deception, fraud, false pretenses, misrepresentations as well as the concealment, suppression and omission of multiple material facts, with intent that Preci-Dip's current and potential customers rely upon the concealment, suppression and omission of the material facts

45. As a result of Tri-Star's willful and malicious conduct, Preci-Dip is likely to suffer, and has in fact already suffered, damage and irreparable harm for which it has no adequate remedy at law. Unless this Court enjoins Tri-Star's conduct, Preci-Dip will continue to suffer irreparable harm.

COUNT VI

Unfair Competition

46. Preci-Dip realleges and incorporates herein the preceding paragraphs 1 – 45 of this Complaint.

47. Tri-Star's blatant misrepresentations to current and potential customers as to the characteristics of Preci-Dip's products, as well as the false allegations of Preci-Dip's infringement of Tri-Star's '974 Patent amount to an intentional misappropriation of Preci-Dip's name, reputation and commercial advantage. As a result of Tri-Star's willful and intentional misappropriation and tarnishment of Preci-Dip's valuable goodwill, Tri-Star will be unjustly enriched.

48. Tri-Star's acts described above constitute unfair competition in violation of Illinois common law, as the aforementioned acts amount to an intentional misappropriation of Preci-Dip's reputation and commercial advantage.

49. As a result of Tri-Star's aforesaid conduct, Preci-Dip has suffered substantial damage and irreparable harm constituting an injury for which Preci-Dip has no adequate remedy at law. Unless this Court enjoins Tri-Star's conduct, Preci-Dip will continue to suffer irreparable harm.

COUNT VII

Tortious Interference with Business Relationships and with Prospective Business Advantage

50. Preci-Dip realleges and incorporates herein the preceding paragraphs 1 – 49 of this Complaint.

51. Based on its nationwide relationship with its retailers and customers, Preci-Dip had and has valid business relationships and contracts with existing customers as well as potential customers for its many products, including the Preci-Dip Reversed Clip Contacts.

52. On information and belief, Tri-Star had knowledge of Preci-Dip's business relationships and contracts with existing customers, as well as with potential customers, for its many products, including the Preci-Dip Reversed Clip Contacts.

53. On information and belief, Tri-Star wrongfully, intentionally and in bad faith interfered with and sought to prevent contract formation, procure contractual breach and induce termination of Preci-Dip's business relationships and contracts with existing customers, as well as with potential customers, for Preci-Dip's many product lines, including the Preci-Dip Reversed Clip Contacts. Tri-Star's improper and tortious interference stems from its filing of the Tri-Star Complaint, as well as its further improper conversations and maliciously false representations with Preci-Dip's current and potential costumers. Tri-Star enjoyed no privilege and was not justified in its intentional, improper and bad faith actions taken to interfere with Preci-Dip's business relationships.

54. Tri-Star's unlawful conduct has caused and will continue to cause Preci-Dip substantial damage and irreparable harm constituting an injury for which Preci-Dip has no adequate remedy at law. Unless this Court enjoins Tri-Star's conduct, Preci-Dip will continue to suffer irreparable harm.

PRAYER FOR RELIEF

WHEREFORE, Preci-Dip requests that the Court enter judgment in its favor and against Tri-Star as follows:

A. Declaring that the '974 Patent is invalid, void and unenforceable;

B. Declaring that Preci-Dip and Preci-Dip's products do not infringe, and have not infringed, any valid claim of the '974 Patent;

C. Declaring that Preci-Dip has not committed any act of infringement of the '974 Patent;

D. Enjoining Preci-Dip, its officers, agents, employees, representatives, counsel and all parties acting in concert with it, permanently and preliminarily during the pendency of this action, from directly or indirectly asserting or charging infringement of the '974 Patent against Preci-Dip, it's representatives, agents, distributors, customers, contractors, present and prospective;

E. Declaring this an exceptional case under 35 U.S.C. § 285, and rendering an award to Preci-Dip of its reasonable attorneys' fees, expenses and costs in this action;

F. Declaring that Tri-Star's actions complained of above constitute Federal Unfair Competition in violation of 15 U.S.C. § 1125 (a), and enjoining Tri-Star from continuing such acts;

G. Declaring this an exceptional case under 15 U.S.C. § 1117, and rendering an award to Preci-Dip of its damages, as trebled, reasonable attorneys' fees, expenses and costs in this action;

H. Declaring that Tri-Star's actions complained of above constitute a violation of the Illinois Deceptive Trade Practices Act, 815 ILCS 510/1 et seq., and enjoining Tri-Star from continuing such acts;

I. Declaring that Tri-Star's actions complained of above constitute a violation of the Illinois Consumer Fraud and Deceptive Business Practices Act, 815 ILCS 505/1, et seq., enjoining Tri-Star from continuing such acts, and awarding Preci-Dip its damages;

J. Declaring that Tri-Star's actions complained of above constitute a violation of Illinois common law unfair competition and enjoining Tri-Star from continuing such acts;

K. Granting Preci-Dip damages and such other and future relief as this Court deems just and proper.

PLAINTIFF DEMANDS A JURY TRIAL ON ALL ISSUES.

Dated: July 23, 2008

Respectfully Submitted,

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One of the Attorneys for Plaintiff,
Preci-Dip, SA

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William J. Lenz (ARDC# 625 7555)
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NGEDOCS: 1548323.1

EXHIBIT A

US006250974B1

(12) **United States Patent**
Kerek

(10) **Patent No.: US 6,250,974 B1**
(45) **Date of Patent: Jun. 26, 2001**

(54) **HOODLESS ELECTRICAL SOCKET CONTACT**

(75) Inventor: **Leslie Laszlo Kerek**, Los Angeles, CA (US)

(73) Assignee: **Tri-Star Electronics International, Inc.**, El Segundo, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/395,515**

(22) Filed: **Sep. 14, 1999**

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/104,733, filed on Jun. 25, 1998, now abandoned.

(51) **Int. Cl.**[7] **H01R 13/187**
(52) **U.S. Cl.** **439/843**
(58) **Field of Search** 439/843, 851, 439/856, 845

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,720,157	*	1/1988	Nestor et al.	439/851
5,108,318	*	4/1992	Sakurai et al.	439/843
5,186,663	*	2/1993	Wymelenberg	439/843
5,667,413	*	9/1997	Trafton	439/843

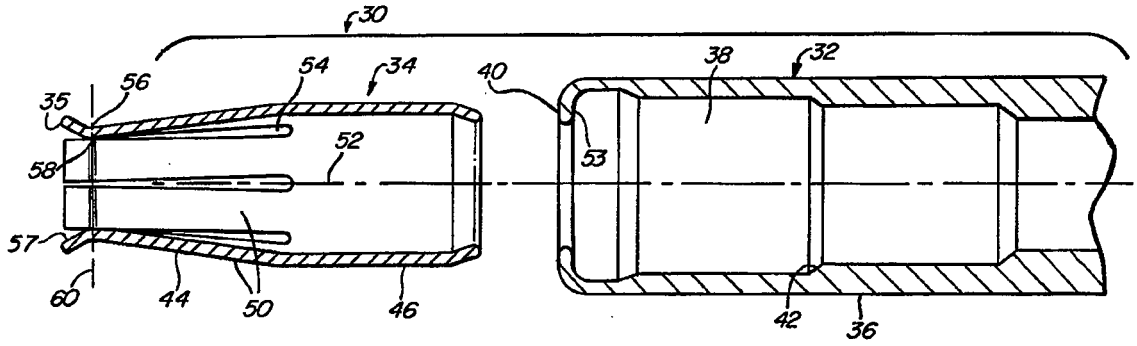
* cited by examiner

Primary Examiner—Brian Sircus
Assistant Examiner—Javaid Nasri
(74) *Attorney, Agent, or Firm*—Harold L. Jackson

(57) **ABSTRACT**

A connector terminal is disclosed including a cylindrical socket body with a spring contact inserted therein. The spring contact has a distal portion that establishes a press fit with the socket body. The socket body may be crimped over the distal portion to more securely hold the spring contact in the socket body. The spring contact further has a plurality of fingers which taper forwardly and inwardly to resiliently grab a male pin as it enters the socket.

20 Claims, 5 Drawing Sheets



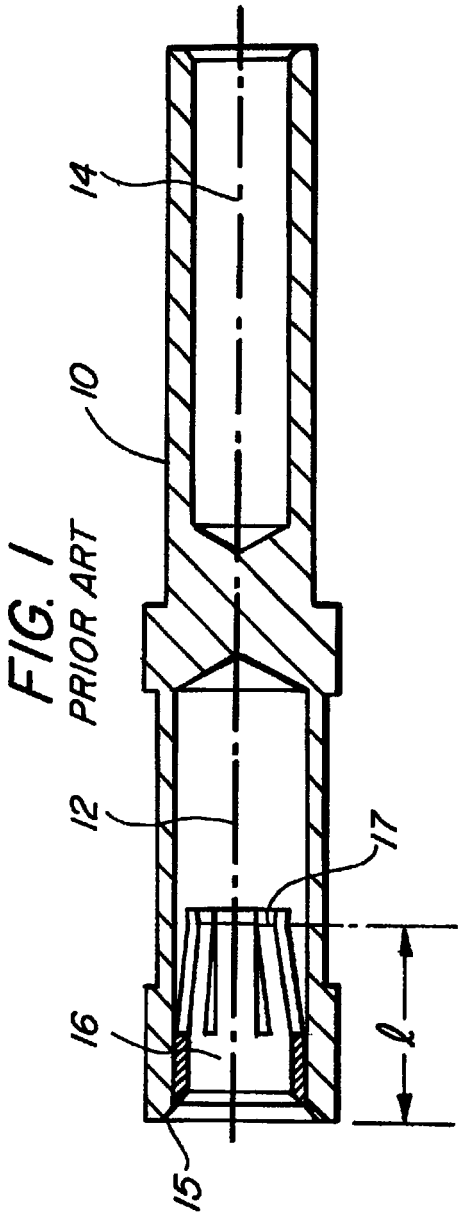


FIG. 1
PRIOR ART

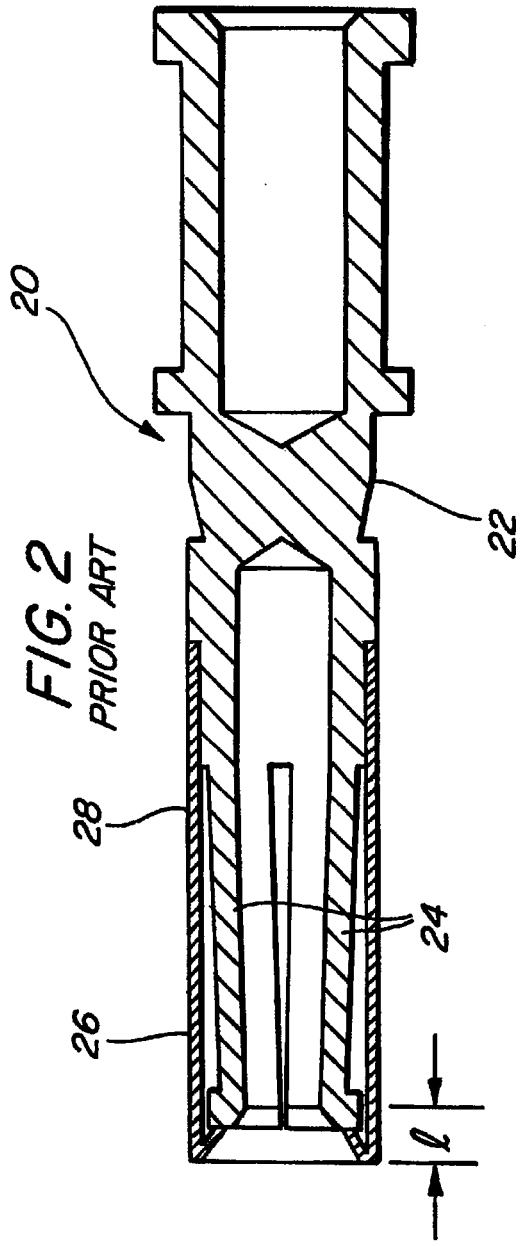


FIG. 2
PRIOR ART

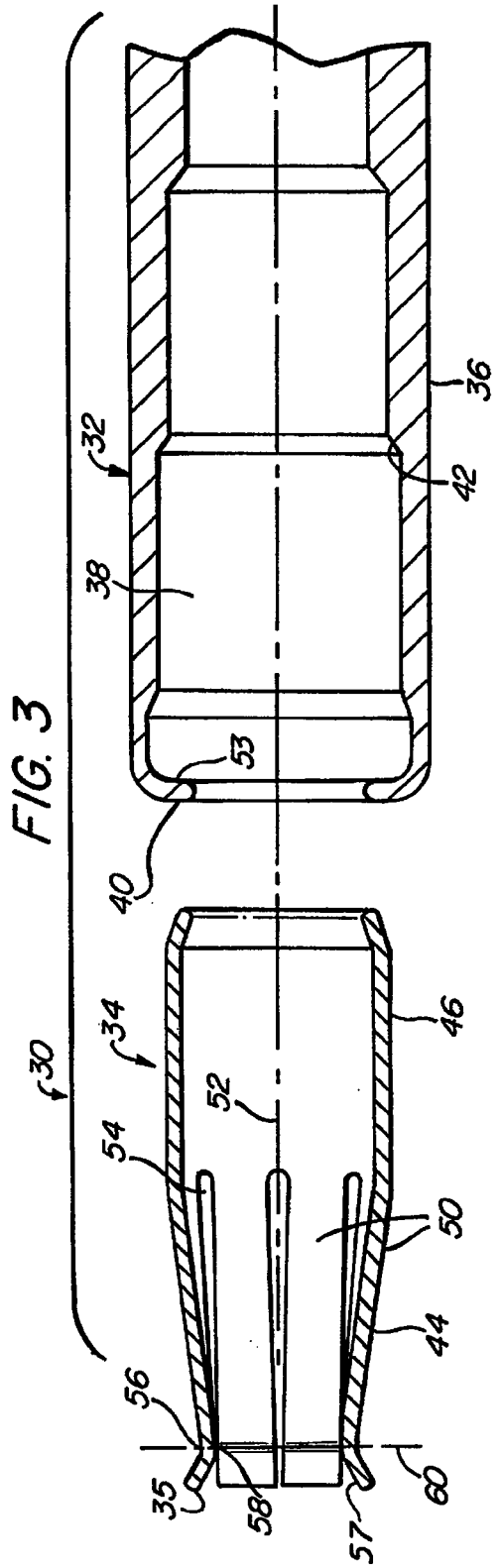

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FIG. 3

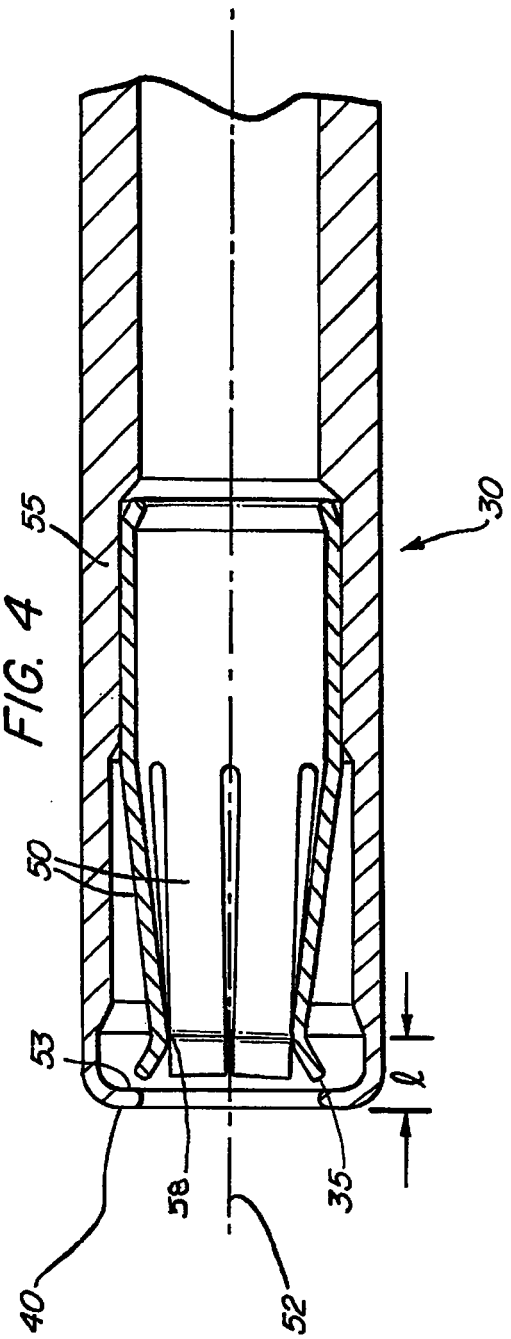
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FIG. 4

FIG. 5

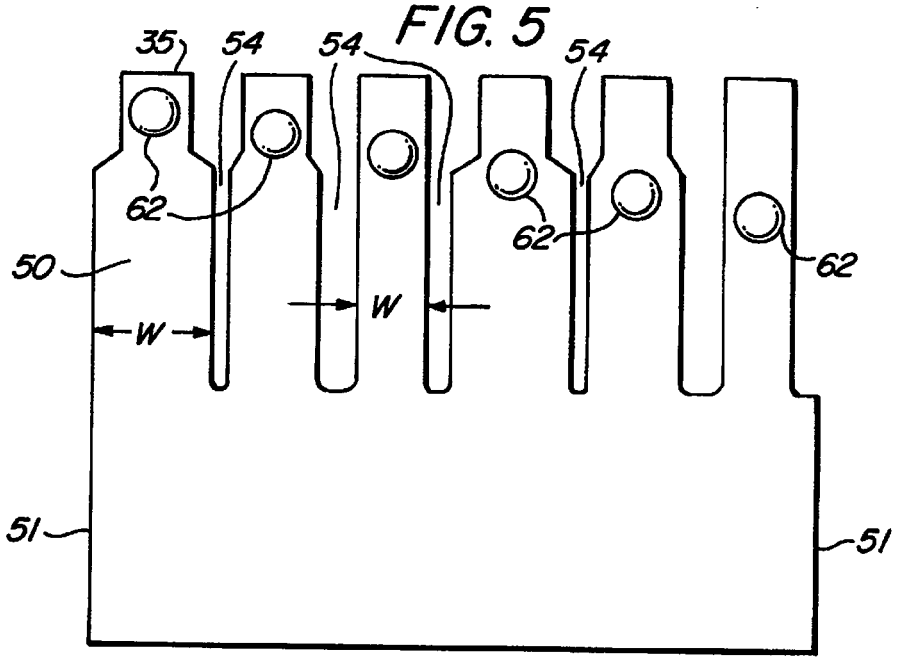


FIG. 6A

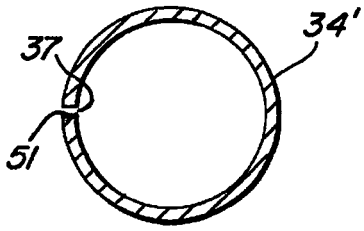


FIG. 6B

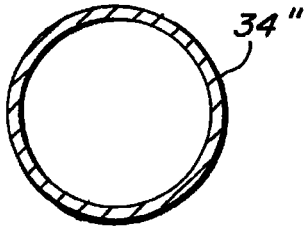
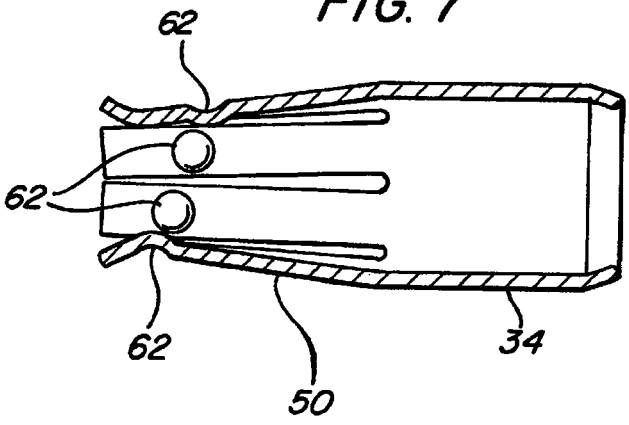


FIG. 7



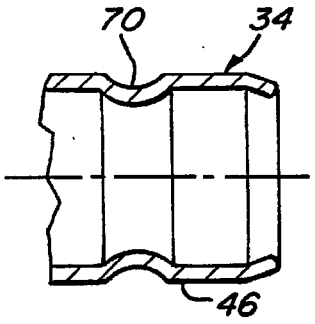


FIG. 8A

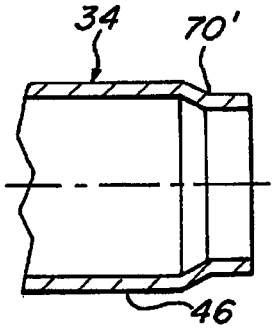


FIG. 8B

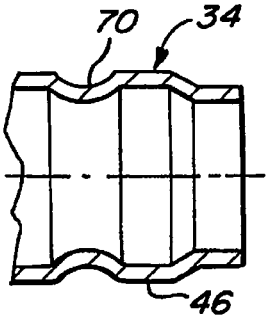


FIG. 8C

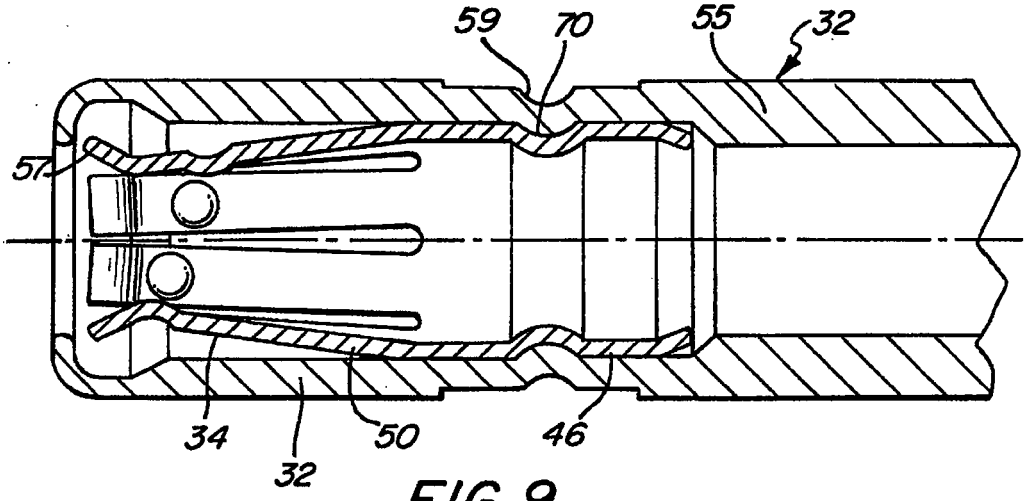


FIG. 9

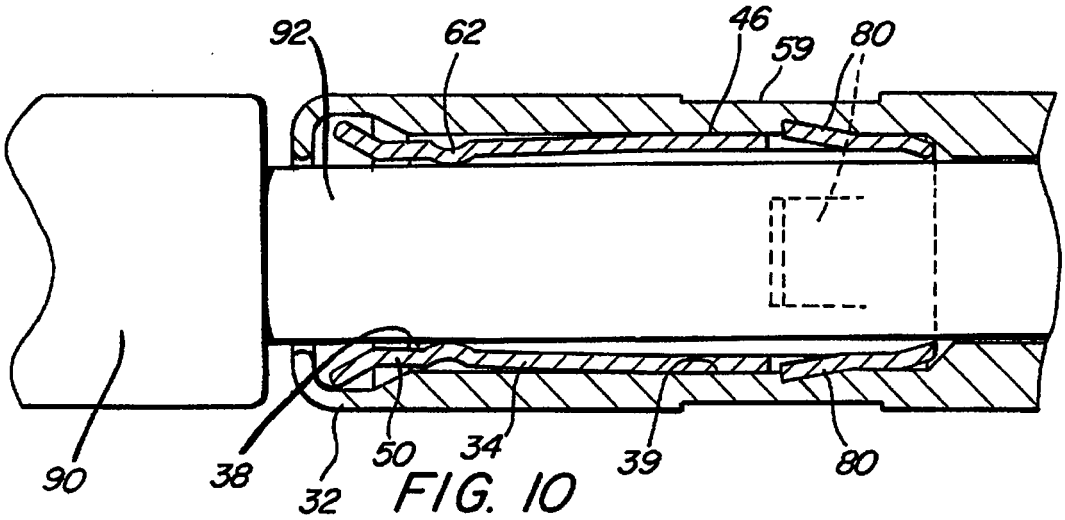


FIG. 10

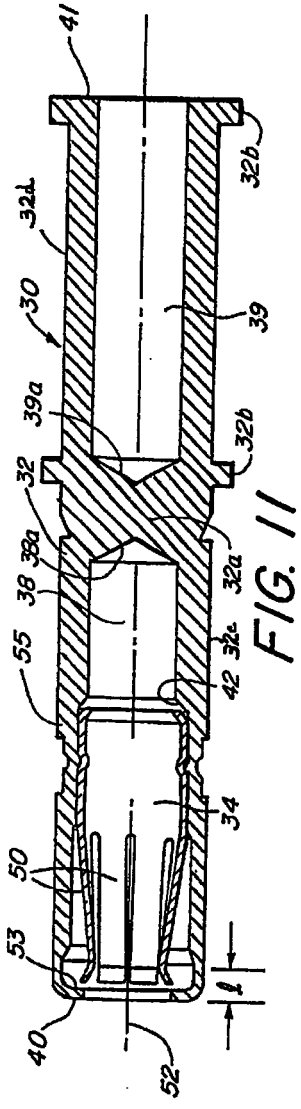


FIG. 11

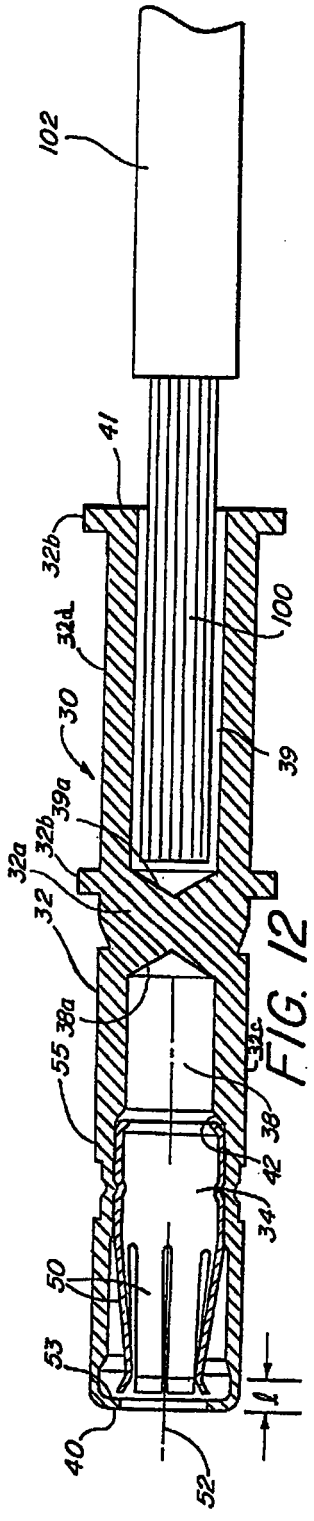


FIG. 12

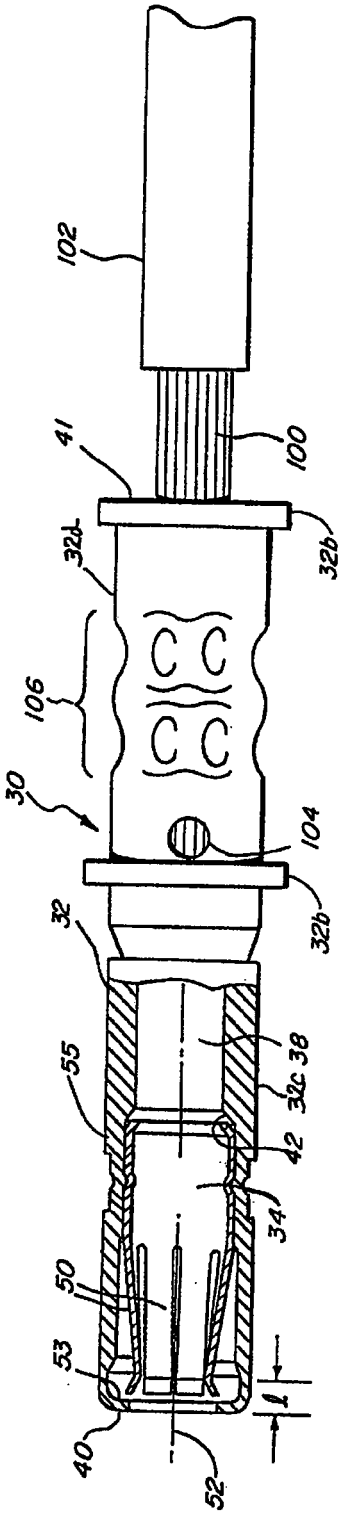


FIG. 13

HOODLESS ELECTRICAL SOCKET CONTACT

RELATED APPLICATION

This application is a continuation-in-part of my application Ser. No. 09/104,733 filed Jun. 25, 1998 entitled Hoodless Electrical Socket Connector which was abandoned on Feb. 4, 2000.

FIELD OF THE INVENTION

This invention relates generally to electrical contacts, and more particularly, it is directed to a hoodless socket contact and method for making the same.

BACKGROUND OF THE INVENTION

Electrical contacts are present in all avionics, military and aerospace equipment environment such as in helicopters, missiles and planes. Such equipment may have dozens or even hundreds or even thousands of electrical connections that must be made between electronic power supplies, sensors, activators, circuit boards, bus wiring, wiring harnesses, to provide the electrical pathways or highways needed to transport electricity in the form of control signals and power. The hardware reliability requirements for operating in an avionics environment are stringent as a failure can have catastrophic consequences. As such, the electrical components and circuitry, as well as the connectors and contacts therein employed to electrically connect these items, must work in a wide range and wide variety of environmental conditions such as mechanical, vibration, wide temperature ranges, humidity and corrosive elements, etc. For example, military standards (also known in the industry as mil specs) for aircraft avionics equipment require that contacts be able to mate and unmate a minimum of five hundred times without a failure during all anticipated environmental and mechanical conditions. In addition, the contact assemblies must be protected to withstand repeated handling without significant distortion or damage to the interconnecting parts which could lead to a lack of electrical continuity.

One example of a high-amperage power socket contact or terminal is illustrated in U.S. Pat. No. 5,376,012 "Power Port Terminal" to Clark which includes a contact socket receiving portion and an integral mounting portion. The socket includes a web with a plurality of beams thereon. Each of the beams has a curved surface with a bend, which beams cooperate to form an axially extending tubular socket region which accepts a pin terminal of any desired length. Disadvantageously, the beams are exposed and therefore subject to damage. Additionally, the beams of the socket contact are not protected from entry of an oversize male contact, which may bend the beams beyond their elastic limit thereby damage the connector so that it will not perform electrically.

Another example of a socket contact is illustrated in U.S. Pat. No. 4,906,212 entitled "Electrical Pin and Socket Connector" to Mixon, Jr. which includes a socket have a cylindrical mating portion defined by cantilever beams having one or more blades wherein one or more of the blades include a rearwardly extending free end. The pin includes a mating portion having a bullet nose at one end and a wire barrel at another end. This connector suffers from the same limitations as the Clark connector and therefore is an undesirable alternative in environments where high reliability is critical.

A prior art female contact which is used in non-critical and in non-aerospace applications is shown in FIG. **1** which contact includes a cylindrical member **10** having holes **12** and **14** in the ends thereof. A spring member **16** is inserted in one of the ends, the spring member tapering rearwardly into the hole **12**. Accordingly, a male pin contact inserted into the cylindrical member **10** would be grasped by the spring member **16** relatively deeply within the hole **12** which is disadvantageous. The distance from the free end **15** of the socket to the point of engagement **17** with a male contact or pin is designated by the letter "l" in FIG. **1** (and in FIG. **2**). The particular connector halves in which the male and female contacts are used (and the positioning of the connector halves on the equipment, e.g., trays and black boxes) may result in a lesser or greater penetration of the male pins into the socket body. Furthermore, there is no mechanical structure to ensure that the spring member **16** will remain in place and as such the spring may "walk out" of the hole during vibration or during mating and unmating cycles. Mil specs require that a spring member which provides the electrical continuity must be able to withstand the separation force during the unmating cycle (i.e., 500) without being dislodged under all anticipated environmental conditions including vibration. The arrangement of the spring **16** socket member **10** could be potentially hazardous if used in avionics environments where high reliability is a must for human safety.

Another example of a socket contact that is successfully manufactured and sold by the assignee of the present invention is shown in FIG. **2**. This contact **20**, sometimes referred to as a hooded socket contact, includes a tubular socket body **22** having a plurality of tines **24** for receiving a male contact or pin. A hood **26** is inserted over the tines **24** and rear portion of a contact to protect the tines from damage. The hood is generally made of stainless steel with a wall thickness of only 0.004 to 0.010" for economic and reliability reasons. The hood is press fit over the cylindrical shoulder portion **28** at the rear of the contact. This press fit arrangement, due to the hood's wall thickness, requires precision manufacturing. Improper sizing of the socket body shoulder may result in damage to the hood during the press fit operation or the hood may come loose during use. Plating of the contact may exacerbate the press fit step during manufacturing. Furthermore, a stainless steel hood may not be tolerated in certain applications where interference with magnetic fields is a problem. In summary, the manufacturing steps necessary to insure reliable performance of the hooded type contact shown in FIG. **2** may result in a fairly expensive contact when mass produced.

Accordingly, there is a need for an improved socket contact that is simple to manufacture yet reliable in performance and that can be made in mass quantities at relatively low cost.

SUMMARY OF THE INVENTION

The foregoing mentioned disadvantages are avoided by providing a hoodless socket or female contact for engaging a male pin contact. The female contact includes a socket body with two ends, each end having an axially oriented hole or bore. A spring for making an electrical connection with a male contact or pin is located in one of the holes. The spring is arranged for resiliently engaging the male pin contact in close proximity to the hole entry point or free end of the socket body. Means are provided for securely holding the spring in the hole, which may be established by a press fit of the spring within the hole coupled with an extension of the socket body overlaying a portion of the spring thereby preventing the spring from exiting from the socket body.

Alternatively, the spring may be securely coupled in the socket body by crimping the socket body onto the spring. Preferably, this is achieved by crimping a portion of the socket body into a peripheral annular groove in the spring. Barbs on the spring, which engage the inner wall of the hole of the socket body, may also be employed, with or without crimping, to provide additional security.

The hole at the other end of the socket body is sized and shaped to receive a conductor such as a insulated copper wire. The conductor may be electrically and mechanically secured together with the socket body by crimping the socket body onto the conductor.

The construction and operation of preferred embodiments of the contact of the present invention may best be understood by reference to the following description taken in conjunction with the accompanying drawings in which like components or features are designated by the same or primed reference numbers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side cross-sectional view of a prior art contact;

FIG. **2** is a side cross-sectional view of another prior art contact;

FIG. **3** is a side cross-sectional, partially broken away side view of a socket contact in accordance with the principles of the invention illustrating the two parts of the socket contact prior to assembly;

FIG. **4** is a side cross-sectional, partially broken away side view of the contact parts of FIG. **3** assembled together;

FIG. **5** is a side view of a stamped out spring prior to roll forming;

FIGS. **6**A and B are cross-sectional views illustrating a spring made from roll forming ("seam type") or deep drawn ("seamless type") processes, respectively;

FIG. **7** is a side cross-sectional view of the spring with dimples;

FIGS. **8**A–C are partial side cross-sectional views of the back end of the spring with optional groove configurations therein;

FIG. **9** is a cross-sectional side view of an assembled socket contact that has been crimped;

FIG. **10** is a cross-sectional view of another assembled socket contact wherein the two parts are assembled together and in additional are also retained by barbs and a pin terminal is inserted into the socket contact;

FIG. **11** is a cross-sectional side view illustrating the two parts of the socket contact prior to assembly with an electrical conductor;

FIG. **12** is a cross-sectional side view of the socket contact with metal stands of an insulated conductor wire inserted into the rear portion of the socket body prior to crimping, and

FIG. **13** is a partially broken away side view of the socket contact with the rear portion of the socket body crimped onto the wire strands.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and more particularity to FIGS. **3** and **4**, there is shown a socket contact generally indicated by reference number **30**. The socket contact, sometimes hereinafter referred to as a hoodless socket, is made from two parts including a socket body **32** and a spring **34**. The socket body **32** consists of a cylindrically or

tubularly shaped member **36** having two ends, with an axially disposed male-contact-receiving hole or bore **38** extending from one of the ends **40** (i.e., free end) into the socket body a preselected distance and a conductor or wire receiving hole of bore **39** at the other end **41** thereof. See FIG. **11**. The socket body **32** may be made of an electrically conductive material such as a brass/copper alloy. The male-contact-receiving hole **38** may have an inwardly projecting shoulder **42** that provides a back stop for the seating of the spring **34**.

The spring **34** contains a forward male contact receiving portion **44** and a rear mounting portion **46**. The contact receiving portion **44** includes a plurality of fingers or tines **50**. The fingers are arranged around the longitudinal axis **52** of the spring **34** and are separated by gaps or slots **54** between adjacent fingers. Each of the forwardly extending fingers tapers inwardly to define together a tubularly shaped contact region **56** and **58** which engages a male pin inserted **3** therebetween and to provide a reliable electrical connection therebetween under anticipated adverse conditions. The portion of the fingers forward of the contact region **56** bend outwardly to form a flared region **57** which acts as a centralizer for guiding the insertion of a male pin. The tubularly shaped contact region **56** at the bends define a plane curved contact surface which surface may be in radial plane such as the an annular contact surface **58** at a preselected point **60** along a longitudinal axis **52**. The preselected point for annular contact surface **58** of the spring **34** is spaced within about 0.020 to 0.045 inches, and preferably about 0.035 inches maximum, from the free end **40** of the socket body when the spring contact is secured therewith, i.e., equals about 0.020" to 0.045" and preferably about 0.035" maximum. The distance from the free end **40** of the socket body to the annular contact surface **58** is designated by the letter " " in FIG. **4**. The aforedescribed arrangement between the socket body and spring thus allows electrical contact to be made with a male contact close to the end **40** of the socket body. This advantageously provides electrical contact to be made immediately essentially upon coupling a male contact (not shown) to the hoodless female contact **30**, as required by the applicable mil specs.

The spring **34'** may be of the seam type in which case it is made in a flat configuration, as illustrated in FIG. **5**, and then roll formed into the form of a sleeve. A small gap **37** is formed between the edges **51**, as shown in FIG. **6**A. This gap may visually disappear as a result of the roll formation and press fit steps. Alternatively, the spring **34'** may be of the seamless type made, for example, by deep drawing process well known in the art, as shown in FIG. **6**B.

While the fingers **50** described hereinabove provide good electrical continuity to a male terminal, increased electrical contact may be established by providing the contact region **56** with inwardly disposed dimples **62**, as shown in FIG. **7**. While the dimples could be disposed on the same radial plane, preferably the dimples **62** are staggered on the fingers **50**, i.e., disposed at different axial distances from the free end of the socket body as shown more particularity in FIG. **5**. This advantageously reduces the insertion force needed to insert a male pin between the fingers **50** than when the dimples **62** are all on the same radial plane, while increasing the retention force provided by the fingers **50**. Additionally, by staggering the dimples **62**, the resonance point of the individual fingers **50** will vary during vibration, thus mitigating open circuit faults. Fingers having different widths "W", as illustrated in FIG. **5**, also aid in overcoming the resonance problem encountered with conventional spring contacts. The dimples **62** further assure that a gas-tight

connection is established between the fingers and a male contact. Such a gas-tight connection seals out corrosive gases and thereby prevents formation of films or corrosives on the surfaces interconnecting the mating male/female contacts that could degrade the electrical conductivity therebetween and cause failures in the connection. It should be noted that dimples or fingers having differing widths may not be necessary in many applications.

The spring **34** may be retained within the hole **38** of the socket body **32** by inserting the contact into the socket body with a press fit configuration and thereafter rolling the free end of the socket body radially inwardly to form an annular shoulder **53** which will engage end **35** of the spring in the event that a sufficient force is applied to the spring tending to pull the spring out of the socket body. See FIG. **4**. Alternatively, or in addition thereto, the rear mounting portion **46** of the spring contact may have an annular groove **70** therein, shown with more particularity in FIG. **8**A. After assembly, the wall of the socket body **32** may be roll crimped such that a portion **59** of the socket body wall is rolled into the groove **70**, as shown in FIG. **9**. The rear mounting portion **46** of the spring **34** may have a variety of groove configurations, as shown with more particularity in FIGS. **8**A–C.

Another means for retaining the spring in the socket body is shown in FIG. **10**. In this embodiment, the rear mounting portion **46** of the spring has a plurality of outwardly extending spring retention barbs **80**. The barbs **80** resiliently compress inward upon insertion of the spring **34** into the hole **38**, but dig into the inner wall **38** of the hole to resist removal. As further illustrated in FIG. **10**, the pin portion **92** of a male contact **90** is inserted between fingers **50** which spread to resiliently grasp the pin portion **92** via the dimples **62**. It should be noted that the dimples **62** are optional.

FIGS. **11–13** illustrate an attachment mechanism for electrically connecting the socket body **32** to an electrical conductor **102**, such as a conventional insulated copper wire, for example. The socket body **32** includes a forward (first) tubular portion **32***c* and a rearward (second) tubular portion **32***d* separated by a solid center section **32***a*. The second or rearward portion **32***c* forms a wire receiving end **41** which opens to a rear hole or blind bore **39** which receives the copper strands **100** of insulated wire **102**. The first or forward tubular portion **32***c* includes the male contact receiving blind bore **38** discussed previously. The front and rear bores **38** and **39** are closed by end walls **38***a* and **39***a*, respectively, formed by center section **32***a* of the socket body. The socket body **32** includes a pair of spaced radially extending shoulders **32***b*.

As is shown in FIG. **12**, the wire strands **100** of the conductor **100** are inserted a predetermined distance into hole **39**, which insertion may be aided by a small viewing hole **104** (shown in FIG. **13**). The distal end wall **39***a* of the hole **39**, in any event, limits the insertion distance of the wire. A selected portion **106** of the socket body **32**, extending over the wire strands **100**, is crimped onto the wire strands to make good electrical contact therewith and mechanically hold the wire strands **100** in the socket body **32**, as shown in FIG. **13**. Advantageously, the socket body while serving to hold and protect the spring also provides for direct attachment to conductor wires and the like without the need for additional parts. It should be noted that while it is preferable to provide separate front (first) and rear (second) holes, **38** and **39**, respectively, separated by a center section **32***a* of the socket body, the hole or bore could be continuous, i.e., one long bore.

There has thus been described an improved contact arrangement which can be cost effective manufactured on a repetitive basis. This spring is protected from damage by the socket body. The dimples, when utilized, provide an increased gas tight point(s) of contact, allowing thinner or less noble electrical conductive plating to used on the fingers. Optionally, staggering the dimples reduces the overall mating and unmating force while maintaining a desired gas tight seal between the fingers and the male contact. Accordingly, various modifications of the hoodless socket, and processes involved in manufacturing the contact terminal, will occur to persons skilled in the art without involving any departure from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A two piece hoodless female contact for engaging a male pin comprising:

a socket body forming one piece of the contact, the socket body having a first tubular portion and a second portion extending alone a longitudinal axis, the first portion having an axial hole therein defining an open free male contact receiving end, the second portion having an open wire-receiving end for connection with an electrical conductor; and

a separate spring forming another piece of the contact, the spring being located in the axial hole defining the male contact receiving end of the first tubular portion, the spring including a forward portion and rear portion, the forward portion having a plurality of forwardly and inwardly extending fingers which terminate near the free male contact receiving end of the first tubular portion for resiliently grasping a male pin in close proximity to the free male contact receiving end.

2. The contact defined in claim **1** wherein the socket body further includes a third portion in the form of a solid generally cylindrical section disposed between the first and second portions and wherein each of the fingers includes a male pin engaging surface and wherein the male pin engaging surfaces of the fingers are arranged to grasp the male pin at a distance along the longitudinal axis within a range of about 0.025 to 0.045 inches from the free male contact receiving end of the socket body.

3. The contact defined in claim **2** wherein each of the fingers flare outwardly and forwardly of the respective pin engaging surface thereof for facilitating insertion of the male pin in between the fingers.

4. The contact defined in claim **1** wherein each of the fingers has an inwardly disposed dimple which forms the pin engaging surface for engaging the male pin.

5. The contact defined in claim **4** wherein the dimples are staggered along the lengths of the individual fingers with the dimples being positioned at different axial distances from the free male contact receiving end of the first tubular portion of the socket body.

6. The contact defined in claim **1** wherein the first tubular portion of the socket body is crimped onto the rear portion of the spring.

7. The contact defined in claim **1** wherein the forward portion of the spring terminates axially inwardly of the free male contact receiving end of the first tubular portion of the socket body and wherein the free end of the first tubular portion of the socket body is rolled over to extend radially inwardly beyond the forward portion of the spring to prevent removal of the spring from the hole and to center a mating pin contact.

8. A two piece female contact comprising:

a cylindrically shaped socket body member formed as a single part comprising one piece of the contact, the socket body member having first and second tubular

portions separated by a solid center portion extending along a longitudinal axis, the first tubular portion defining a first axially disposed blind bore with a free end for receiving a male contact, the second tubular portion defining a second axially disposed blind bore sized and shaped to receive an electrical conductor; and

a separate male contact engaging spring forming another piece of the female contact, the spring being seated entirely in the first bore, the spring having front and rear portions, the front portion of the spring having a female coupling portion adjacent to the free end of the first tubular portion of the socket body member and the rear portion of the spring and the first tubular portion of the body member having cooperative securing means for securely holding the spring in fixed position within the body member.

9. The contact defined in claim **8** wherein the first tubular portion of the socket body member defines a tubular wall and wherein the cooperative securing means comprises a selected portion of the tubular wall being roll formed into the rear portion of the spring.

10. The contact defined in claim **8** wherein the first blind bore has an inwardly projecting shoulder, the rear portion of the spring seating against the shoulder to inhibit rearward movement of the spring within the first blind bore of the body.

11. The contact defined in claim **8** further comprising a male pin adapted to be inserted into the front female coupling portion of the spring, the female coupling portion having a plurality of forwardly projecting fingers which are arranged to engage the male pin inserted therebetween in close proximity to the free end of the first blind bore.

12. The contact defined in claim **11** wherein the fingers have male pin engaging surfaces which are arranged to engage the male pin at a distance of within the range of about 0.025 to 0.45 inches from the free end of the first blind bore.

13. A male/female contact system for coupling a male pin contact to a female socket contact, comprising:

a male pin contact;

a female socket contact formed in two separate pieces, the first piece being in the form of a tubular socket member having a first blind bore therein with an open free end and having a second blind bore therein sized and shaped for receiving an electrical conductor, the tubular socket member consisting of a single part; and

the second piece of the female socket contact being a spring member in the form of a sleeve seated in the first blind bore of the tubular socket member and establishing a press fit therein to prevent movement of the spring member relative to the tubular socket member, the spring member having a forwardly extending female coupling portion terminating adjacent the open free end of the first blind bore, said male pin contact being inserted into the open free end and grasped by the female coupling portion.

14. The male/female contact system defined in claim **13** wherein the tight fit between the socket and spring member is established by burrs on one of the members which dig into the other member.

15. The contact defined in claim **13** wherein the spring member has an indentation and the tubular socket member has a cooperative indentation seated therewith for securely holding the two members together.

16. The contact defined in claim **13** wherein the female coupling portion grasps the male contact at a distance within the range of about 0.025 to 0.045 inches of the open free end of the first blind bore.

17. A method for making a two piece female socket contact comprising the steps of:

forming a sleeve spring member having a rear end and a female coupling portion at a forward end;

forming a separate one piece socket body having first and second tubular portions separated by a solid center section, each of the first and second portions having a wall surrounding a blind bore therein, the blind bore in the first tubular portion having a free open end for receiving the spring member and the blind bore in the second tubular portion adapted to receive a conductor;

inserting the spring member entirely within the blind bore in the first tubular portion of the socket body to form a press fit with the female coupling portion being positioned adjacent to the free open end of the blind bore in the first tubular portion;

providing an electrical conductor; and

inserting the electrical conductor into the blind bore in the second tubular portion and crimping the wall of the second tubular portion onto the electrical conductor.

18. The method of claim **17** further comprising the step of:

providing a male contact; and

inserting the male contact into the spring contact female coupling portion establishing an electrical coupling therebetween.

19. The method of claim **17** wherein the female coupling portion of the spring member is formed with a plurality of resilient fingers which are spread apart upon the insertion of a male contact.

20. The method of claim **19** wherein the plurality of resilient fingers of the spring member have a proximal end positioned adjacent the free open end of the blind bore in the first tubular portion of the socket body and further including the step of rolling the wall of the first tubular portion of the socket body adjacent the free open end of the blind bore in the first tubular portion to form an inwardly projecting shoulder which limits the outward movement of the spring member and and inhibits damage to the spring member by an oversize mating male pin.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,250,974 B1
DATED : June 26, 2001
INVENTOR(S) : Kerek

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 2,
Line 11, "1" should read -- "[" --.

Column 4,
Line 19, delete "3".
Line 26, delete "an".
Line 35, " ", should read -- "[" --.

Column 6,
Line 18, "alone" should read -- along --.
Line 29, delete "free".
Line 31, delete "free".

Signed and Sealed this

Twenty-sixth Day of March, 2002

Attest:

Attesting Officer

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

EXHIBIT B

US006264508B1

(12) **United States Patent**
Lehmann

(10) **Patent No.: US 6,264,508 B1**
(45) **Date of Patent: Jul. 24, 2001**

(54) **FEMALE TYPE CONTACT PIECE ENABLING ELECTRICAL CONTACT WITH A MALE ELEMENT**

(75) Inventor: **Pierre Lehmann**, Courcelon (CH)

(73) Assignee: **Preci-Dip Durtal SA**, Delemont (CH)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/499,638**

(22) Filed: **Feb. 8, 2000**

(30) **Foreign Application Priority Data**

Nov. 30, 1999 (EP) 99811102

(51) **Int. Cl.**[7] **H01R 13/187**
(52) **U.S. Cl.** **439/843**
(58) **Field of Search** 439/843, 844, 439/851, 852, 853, 854

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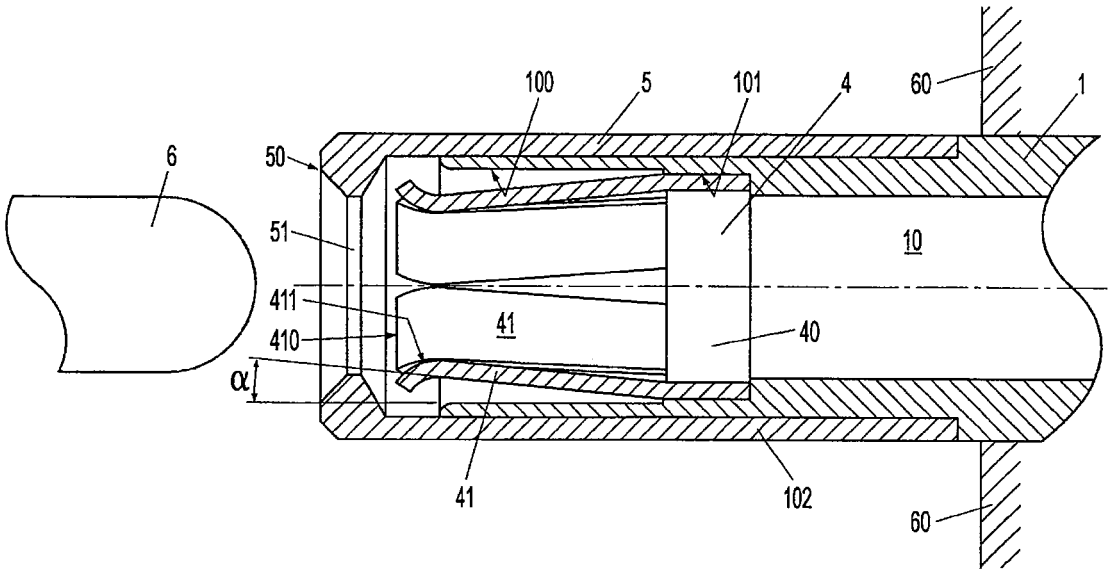
Assistant Examiner—Brian S. Webb
(74) *Attorney, Agent, or Firm*—Oliff & Berridge, PLC

(57) **ABSTRACT**

The contact piece **(1)** comprises a portion of female type able to accommodate a corresponding portion of male type. This female type portion includes a contact clip **(4)** provided with elastic fingers **(42)** oriented towards the opening of a lodging **(10)** destined to accommodate said male type portion. The piece is completed with a bushing **(5)** encircling the clip and provided with a front side **(50)** comprising a passage opening **(51)** serving as gauge, accepting or refusing the passage of a male portion according to its diameter. In this manner, the elastic fingers **(42)** always operate in an elastic mode and never suffer a permanent deformation. Such a disposition has many other advantages.

20 Claims, 2 Drawing Sheets



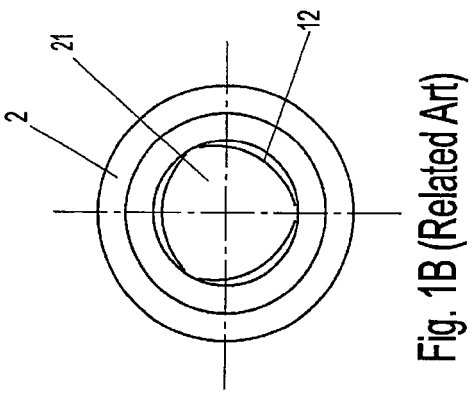


Fig. 1B (Related Art)

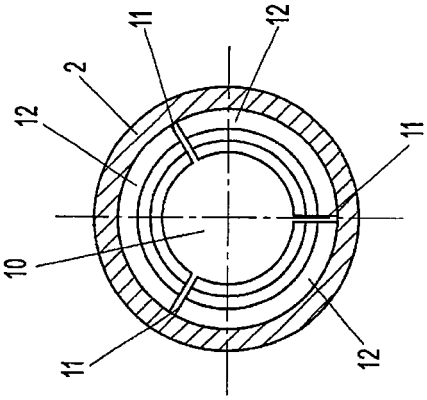


Fig. 1C (Related Art)

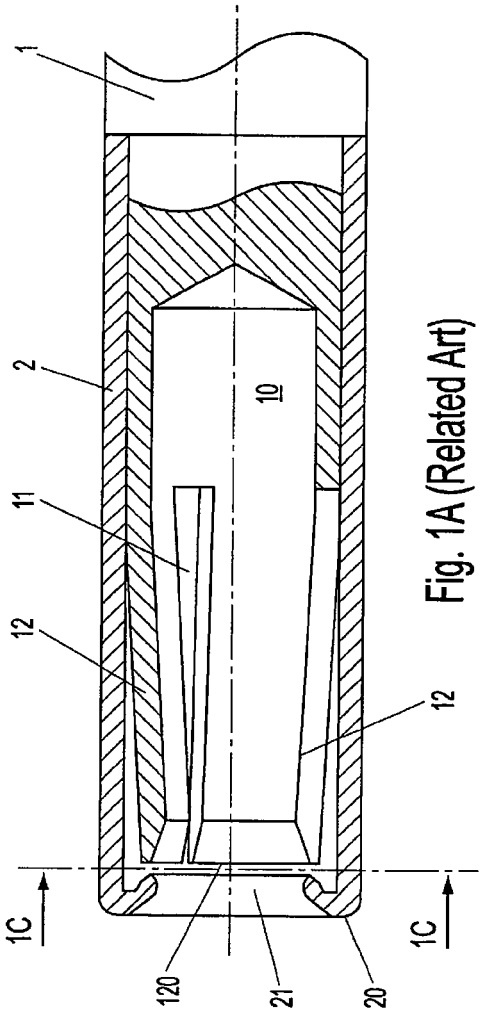


Fig. 1A (Related Art)

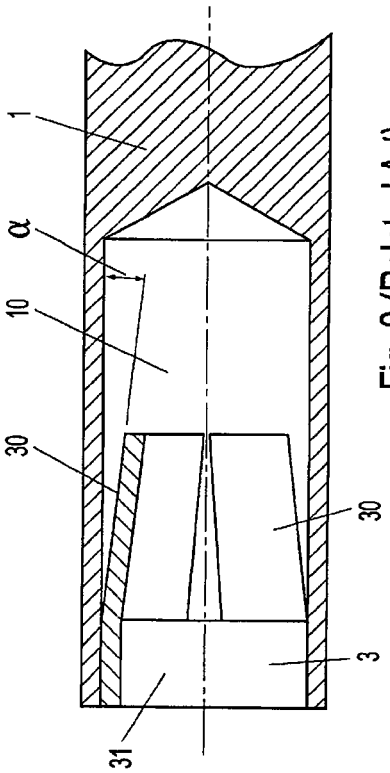


Fig. 2 (Related Art)

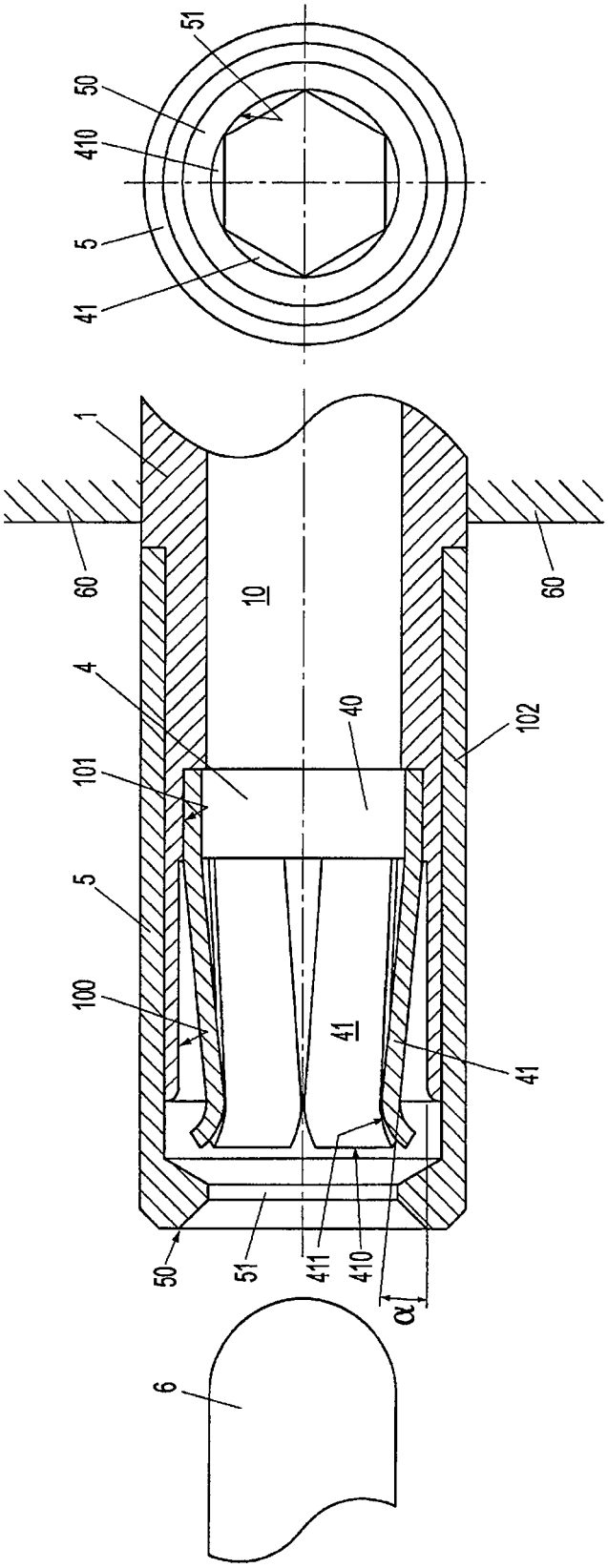


Fig. 3B

Fig. 3A

FEMALE TYPE CONTACT PIECE ENABLING ELECTRICAL CONTACT WITH A MALE ELEMENT

The content of Application No 99811102.5, filed Nov. 30, 1999 in Europe, is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention concerns a contact piece of the female type usable in a connector, for example a connector answering the MIL norm or any other specification, or for any other application, such as for example in an integrated circuit base, or destined to be placed on a printed circuit board. The invention concerns more particularly the portion of this contact piece destined to accommodate the corresponding element of the male type.

2. Description of the Related Art

Several specifications or norms, notably the MIL norms and in particular the MIL-C 39029 norm, define a certain number of characteristics which this portion of the contact piece must comply with, for example contact resistance, engagement and separation force of the male contact piece, depth of engagement of the male piece before contact is established etc. According to these norms, these various parameters are to be measured both when the pieces are new as well as after multiple uses, and this under very diverse environmental, temperature, humidity and other conditions.

In order to attempt to comply with these requirements, manufacturers have proposed various constructions of this portion of the contact piece.

Several known embodiments of such portions of contact pieces will be described further below, in connection with FIGS. 1A and 1B as well as FIG. 2 ; these embodiments encounter notably the following disadvantages according to the constructions described : need to work the entire contact piece in a costly metallic alloy since it must have excellent electrical conduction properties as well as excellent mechanical properties, notably spring power, need to heat treat at least several portions of the piece in order to give it the necessary mechanical characteristics, need to cover the whole piece, or an important portion thereof, with costly plating, of gold or silver, in order to give it the necessary electrical characteristics, difficulty to comply with certain norm requirements, notably MIL norms, lack of any possibility of interchanging the different elements of the contact piece, etc.

SUMMARY OF THE INVENTION

An object of the present invention is thus to propose a contact piece comprising notably a female portion destined to accommodate a corresponding male portion, of improved construction relatively to the known contact pieces, so as to avoid the aforementioned inconveniences of these contact pieces.

To achieve this object, a contact piece is proposed as described in the independent claim, particular embodiments or variants being described in the dependent claims. The last claims indicate more precisely some possible uses of such a contact piece.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in detail below, this description, which further includes certain advantages of the invention, making reference to the attached drawing comprising the figures, in which:

FIGS. 1A, 1B and 1C represent a portion of a contact piece according to a prior art construction, seen in partial longitudinal section, in elevational projection and in cross section, respectively,

FIG. 2 represents a portion of a contact piece according to another prior art construction, seen in partial longitudinal section, and

FIGS. 3A and 3B represent a portion of a contact piece according to a preferred embodiment of the invention, seen in partial longitudinal section and in elevational projection, respectively.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following description as well as in all the figures, only the female type portion of the contact piece **1**, destined to accommodate a corresponding male type element, will be mentioned or represented. This male element is constituted of a pin, its mating end being hemispherical or shaped like a truncated cone, and having a determined diameter. This male element can be the male portion of a corresponding contact piece or else a pin of an integrated circuit or even a connecting part of an electronic component etc. The other portion of the contact piece **1**, not described or represented here, can be of any known type for this kind of contact piece and can comprise for example a portion in which a wire can be crimped, screwed or soldered, or a fastening portion on a connector or printed circuit board or a second female type portion to constitute a transition contact piece, etc.

According to the simplest embodiment known, the portion of the contact piece which is of interest here is constituted of an axial bore of one of the contact piece's extremities, followed by the making of radial slits on a portion of the length of the tubular portion realized by the bore, so as to form elastic tongues or fingers. These fingers are then pressed together so as to form an elastic clamp. This construction has many inconveniences, namely a risk of permanent deformation of one or many of the fingers in the case of the askew engagement of a male element or the engagement of a male element of too big a diameter. Furthermore, although the contact piece is constituted of only one piece, it is costly as the necessary material must have the electrical and mechanical properties required for its functioning.

A first advantages modification made to the above contact piece includes in covering the portion in question with a bushing, as seen in FIGS. 1A, 1B and 1C. One can see in these figures the contact piece **1**, constituted essentially of a metallic pin of which one end, visible in the figure, is destined to accommodate a male element, not visible in the figures. The other end of the contact piece, not visible in the figures, is worked in a conventional manner to fulfil any known function of such a contact piece. It can be seen that the portion of the contact piece **1** which is of interest here has been bored axially, so as to build a lodging **10** in which the male element will come to be lodged. Slits **11**, three in the embodiment represented here, have been shaped in order to separate three fingers **12**. The free extremities **120** of these three fingers **12** are then pressed together, by permanent deformation, so as to close slightly the clamp formed by the three fingers, as can be seen in the figures. As described so far, this construction represents the first embodiment described previously. In order to prevent too strong an opening movement of the fingers **12**, this portion of the contact piece is provided with a tube-shaped bushing **2**, affixed by crimping or any other means onto the portion of

the contact piece **1** behind the fingers **12**. This bushing **2** abuts against the external surfaces of the fingers **12**, preventing these from being moved apart too much.

The extremity of bushing **2** facing the opening of lodging **10** comprises an end side **20** provided with a traversing opening **21** coaxial to the longitudinal axis of contact piece **1**, respectively of lodging **10**. The diameter of this opening **21** is determined so as to let pass only a male element of a diameter inferior to that of a male element which would flatten the fingers **12** against the bushing **2**.

The opening **21**, coaxial to the longitudinal axis of the lodging **10** further serves as guiding means of the male element when mating.

Although this latter construction limits the risk of deformation of the fingers **12** when a male element having too wide a diameter or being not aligned is engaged, the pressure applied by the bushing **2** on the fingers **12** when these are apart, notably on the rear portion of these fingers, means that the latter no longer work fully elastically, which in particular decreases the electric conducting qualities of the contact, notably in case of vibrations.

The inconvenience of machining the fingers **12** and the rest of the contact piece **1** from a single rough piece, i.e. of the same material, remains and results in a costly contact piece. For the same reasons, it is difficult and/or expensive to shape the extremities **120** of the fingers so that they become rounded for an easier mating of the male element; a slightly askew engagement of the male element relative to the longitudinal axis of the lodging **10** can result in the male element being brought to bear against the extremity **120** of a finger, leading this finger to be bent towards the inside of lodging **10**, i.e. to the contact piece being destroyed.

FIG. **2** shows a construction proposed to remedy these last flaws.

As previously, one has a contact piece **1** whose extremity that is of interest here is provided with an axial bore forming a lodging **10** for the male element to be accommodated. A contact clip **3** is inserted inside lodging **10**. The contact clip **3** is formed from a metallic band, of a width corresponding to the length of the clip, which is embossed so as to form a lateral strip fitted with several fingers of an essentially trapezoidal shape, projecting on one of the sides of the lateral strip, the larger bases of each finger being adjacent to the lateral strip whereas the small bases are free. The strip is divided in portions, each comprising several trapezoidal fingers of the length of the portion corresponding to the interior perimeter of the lodging **10**. The portion of strip is then coiled, the fingers being then pressed together by their extremities so as to deform them and decrease the inscribed diameter between the free extremities of the fingers. The clip **3** thus formed is inserted in the lodging **10**, the free extremities of the fingers **30** being directed towards the bottom of lodging **10**; the portion **31** of clip **3**, formed by the aforementioned lateral strip, is maintained towards the open extremity of lodging **10** by any known means, insertion, crimping or other.

According to this construction, only clip **3** must be made of an alloy having excellent conductive qualities as well as excellent mechanical qualities of spring power. Therefore, the rest of contact piece **1** can be worked in a cheaper metal or alloy, for example brass. The clip **3** will be constituted preferably of a bronze/beryllium alloy or other.

During the mating of a male element, the fingers **30** move apart in order to clamp said male element. The moving apart of the fingers **30** is also restricted here by the inner surface of the lodging **10**, with the same inconveniences as mentioned above.

Another inconvenience of this construction is that, in view of the low value of the angle α relative to the longitudinal axis formed by the fingers **30** pressed together, relative to the longitudinal axis of the lodging **10**, the length at which it is necessary to engage the male element into the lodging **10** before its extremity comes into contact with the fingers **30** is important. Increasing this angle in order to diminish this distance could lead to the fingers **30** buttressing against the male element when the latter is withdrawn, thus causing it to be spoiled.

All the inconveniences mentioned previously in relation to the known constructions of the prior art are remedied by the construction according to the invention, of which a preferred embodiment is represented in FIGS. **3**A and **3**B. FIG. **3**A shows a male element **6** for connection to the contact piece and a connector, component or printed circuit board **60** fitted to the contact piece.

As previously discussed, one has a contact piece **1** whose extremity destined to accommodate the male element **6** is bored longitudinally so as to form a lodging **10** for accommodating the male element. The open extremity of lodging **10** comprises a first inner cylindrical neck **100**, whose interior diameter is superior to that of lodging **10**, followed by a second inner cylindrical neck **101** whose inner diameter is comprised between that of neck **100** and that of the bottom of lodging **10**.

A contact clip **4** is inserted by the open extremity of lodging **10**, so that its cylindrical portion **40** comes to be positioned on the inner cylindrical neck **101**.

The clip **4** is obtained preferably in a manner rather similar to that which has been described previously for clip **3**. A complementary arching operation towards the outside of the fingers' extremities is conducted when the clips are always assembled in a continuous strip. As an alternative to the trapezoidally shaped lamellae described, one can also have lamellae of a rectangular shape and separation slits of a trapezoidal shape.

The clip **4** is fastened, by pressing in, crimping or any other known means on this inner neck **101**. Unlike what has been described above in connection with clip **3**, the contact fingers **41** of clip **4** have their free extremities **410** facing the opening of lodging **10**. Furthermore, these free extremities **410**, for each of the fingers **41**, are formed so as to present an arched end portion **411**, the free extremity directed towards the exterior being moved away from the longitudinal axis of lodging **10**. This device is completed by an external bushing **5** pressed on and fastened on an outer cylindrical neck **102** of the contact piece **1**. The extremity of bushing **5** facing the opening of lodging **10** comprises an end side **50** provided with a traversing opening **51** coaxial with the longitudinal axis of the contact piece **1**, respectively of lodging **10**. The diameter of this opening **51** is determined so as to let pass only a male element **6** of a diameter acceptable by the contact clip **4**. It can further be seen in the figure that if a male element **6** has been engaged into clip **4**, its diameter being lower than the diameter of opening **51**, the moving apart of the fingers **41** of clip **4** is never restricted by the inner diameter of neck **100**, since it is superior to that of neck **101**, nor by the inner diameter of bushing **5**, since it is greater than that of neck **101**, nor by the inner diameter of bushing **5**, since the latter is dimensioned so as to allow the fingers **41** to move away to a maximum. Thus, for a determined diameter, respectively gauge, of a male element **6** , the corresponding female contact piece comprises a contact clip **4** whose fingers **41** are subjected to an exclusively elastic deformation, on their whole length and on their

whole range of deformation, the diameter limitation of the male element **6** being determined by the calibrated opening **51** of the bushing **5**. This operating method in elastic mode ensures a maximum electrical conductivity of the contact, even in case of vibrations.

The angle α of each finger relative to the longitudinal axis is also small; this angle is typically comprised between 4° and 10°, being preferably comprised between 6° and 8°. In view of the arched portion **411** of the fingers **41**, the male element cannot be buttressed when engaged or withdrawn from the fingers **41**.

Another advantage of the presence of the arched portion is that the fingers **41** thus offer a greater contact surface with the male element, decreasing consequently the contact resistance between the female contact piece and the male contact piece.

Another advantage of this arched portion is a better transmission of the mechanical power between the male element and the clip, notably in the presence of vibrations. A spoiling of the contact surface of the male element in case of vibrations has namely been observed when the extremities of the contact fingers present an edge rather than a rounding as described for this embodiment.

Another advantage of this device is that the length of engagement of the male element before a contact is established is short since the male element meets first the portion of small diameter of the clip **4** formed by the fingers **41** pressed together.

Yet another advantage of this device is that the opening **51**, aligned with the free extremities **410** of the fingers **41** forms a two point guiding means of the mating male element, thus preventing it from engaging askew.

The presence of the bushing **5** over the region of the contact piece **1** where the clip **4** is inserted and fastened ensures a mechanical reinforcement of the latter region by banding, respectively a better fastening of clip **4**.

Tests have shown that when a male element mates with a female contact piece as represented in FIG. **2**, either with a contact clip with the free extremities of the fingers facing the bottom of lodging **10**, one has first a power peak as soon as the contact between the male element and the fingers is established, followed by an approximately constant force of lower value. On the other hand, when a male element engages in a contact piece according to the invention, one has a constant engagement force of low value, without the initial peak. The engaging movement of the male element in the female element is therefore much smoother, thus sparing the state of the male element's surface and reducing the risk of breakage of the male element, notably in the case of a pin of an integrated circuit which must be inserted into a base.

The separate manufacture of the clip and of the rest of the contact piece has many advantages, such as optimizing the choice of material for one or the other components according to the requirements, heat and/or surface treatment adapted for each element, separate management of the stocks of clips and of connecting pieces according to different types, for fastening on connectors, on integrated circuit bases or on printed circuits etc., these different qualities bringing about an overall decrease in the production costs.

The contact piece **1**, with the exception of clip **4**, will be manufactured in a low-cost metal or alloy, for example brass or more particularly brass able to bear the crimping of a conductor in the portion of the contact piece **1** opposite that described in detail here above. The clip **4** will be manufactured preferably in an alloy of bronze and beryllium.

What is claimed is:

1. A contact piece for use with a corresponding male type element, comprising:

a portion having a female type end, and a lodging disposed axially in said portion for accommodating the corresponding male type element, said lodging including a contact clip for ensuring electrical contact between said corresponding male type element and the contact piece, said contact clip including a front extremity provided with a plurality of elastic contact fingers each finger, including a free extremity directed towards an opening of said lodging and a rear extremity in the form of an annular crown on which said contact fingers are fastened, said annular crown being fitted inside of a front part of said lodging.

2. Contact piece according to claim **1**, wherein each of said fingers is inclined by an angle α relative to the longitudinal axis of said lodging.

3. Contact piece according to claim **2**, wherein the angle α is comprised between 4° and 10°.

4. Contact piece according to claim **3**, wherein the angle α is comprised between 6° and 8°.

5. Contact piece according to claim **1**, wherein each finger comprises an arched portion near its free extremity, the edge of said free extremity moving away from the longitudinal axis of said housing.

6. Contact piece according to claim **1**, wherein it further comprises an essentially tube-shaped bushing encircling the portion of the contact piece fitted with said contact clip, said bushing being provided with a front side comprising a passage opening coaxial to the longitudinal axis of the lodging.

7. Contact piece according to claim **6**, wherein the bushing comprises a cylindrical rear portion fastened on a corresponding cylindrical neck of said contact piece.

8. Contact piece according to claim **6**, wherein the passage opening has a diameter which allows a male element with a diameter equal or inferior to a determined diameter to engage and prevents a male element with a diameter greater than a determined diameter to engage in said portion of the contact piece of female type.

9. Contact piece according to claim **8**, wherein the diameter of said lodging in its portion encircling said fingers is greater than the diameter circumscribed by said fingers when these are moved apart by a male element having said determined diameter has been mated in said contact piece.

10. Contact piece according to claim **8**, wherein when a male element having said determined diameter or an inferior diameter is engaged between the fingers of the contact clip, no portion of the contact piece or of the bushing limits the moving apart of said fingers.

11. Contact piece according to claim **8**, wherein when a male element having said determined diameter or an inferior diameter is engaged between the fingers of the contact clip, the moving apart of said fingers is an elastic movement.

12. Contact piece according to claim **8**, wherein said passage opening and the arched portions of the elastic fingers constitute a guiding means of the male element during mating.

13. Contact piece according to claim **1**, wherein said contact piece and the clip are manufactured in different materials.

14. Contact piece according to claim **13**, wherein the contact piece is of brass.

15. Contact piece according to claim **14**, wherein the contact piece is of a brass alloy able to bear crimping.

16. Contact piece according to claim **13**, wherein the clip is of an alloy of bronze and beryllium.

17. Contact piece according to claim **1**, wherein it complies with the norm MIL-C 39029.

18. Connector fitted with at least one contact piece according to claim **1**.

19. Component base fitted with at least one contact piece according to claim **1**.

20. Printed circuit board fitted with at least one contact piece according to claim **1**.

* * * * *

EXHIBIT C

TRI-STAR
Electronics International, Inc.

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Tel: (310) 536-0444
Fax: (310) 536-9322
www.tri-starelectronics.com

January 25, 2006

Mr. Pierre Lehmann, CEO
Preci-Dip Durtal SA
Rue St-Maurice 34
P.O.Box 341
CH-2800 Delemont, Switzerland

Subject: Inquiry into Patented Clip Design

Dear, Mr Lehmann

Tri-Star Electronics has recently become aware of Preci-Dip's Mil-Spec contact with "reversed clip technology" Your published literature states:

"Reversed-clip contacts are presently available in size 12, 16, 20 and 22. this proprietary technology, entirely developed by PRECI-DIP, is protected by international patents."

Tri-Star Electronics has reviewed a number of your patent filings and believe we have reviewed all that relate to this claim. Tri-Star Electronics has also filed a patent, prior to your reference patent filing, that clearly calls out that our clip is outwardly and forwardly facing. Our patents are enforceable in the United States and Europe.

Does Preci-Dip plan to offer for sales these contacts in either the United States or Europe? If so, we believe Preci-Dip may be in violation of Tri-Star's reverse clip contact design. To avoid any future questions or disputes regarding the Preci-Dip claim, I request that you forward your patent and product samples for our office to review.

Best Regards,

Felix Acosta
Director of Engineering
Tri-Star Electronics Int'l, Inc.

CC: David Bouzek, VP & General Manager
Harold Jackson, Patent Attorney

EXHIBIT D

PRECI-DIP DURTAL
CONNECTION TECHNOLOGY

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Tri-Star Electronics Int'l, Inc.
Mr. Felix Acosta
Director of Engineering
2201 Rosecrans Avenue

El Segundo, CA 90245 U.S.A.

Delémont, le 26 avril 2006

CONFIDENTIAL - FOR SETTLEMENT PURPOSES ONLY

Subject: Tri-Star's Patent Infringement Allegations

Dear Mr. Acosta,

Thank you for your April 12 letter.

We have now had an opportunity to investigate, with assistance of patent counsel, and to consider Tri-Star's patent infringement allegations. In particular, we have carefully reviewed the U.S. and Australian patents and their files and the European patent application identified in your February 16 letter, in view of Preci-Dip's products. We have concluded that Preci-Dip's products do not infringe any valid, enforceable claim of Tri-Star's patents and application for a "Hoodless Electrical Socket Contact" because among other reasons, our product has three pieces, including a stainless steel hood.

We trust that our comments conclude this matter, and we thank you for your amicable presentation of your concerns.

Best regards.

Very truly yours,

PRECI-DIP DURTAL SA
Pierre Lehmann, CEO

Cc: James A. Oliff, Patent Attorney

EXHIBIT E

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November 14, 2007

Mr. Pierre Lehmann, CEO
Preci-Dip Durtal SA
Rue St-Maurice 34, PO Box 341
CH-2800 Delemont, Switzerland

Ref: Preci-Dip Durtal letter regarding Patent Issues

Dear Pierre Lehmann.

Felix Acosta and you have corresponded on our concerns regarding our patent on Mil-C-39029 socket contacts and product being sold by Preci-Dip. In your last letter you noted the title of our patent "Hoodless Electrical Socket Contact" and pointed out that your product has three piece construction.

The key and significant characteristics of our patent are of course located in the body of our patent filing and not in the patent title. We have carefully reviewed your actual product as well as your patent filing and the internal design elements definitely and unquestionably conflicts with our patent. For instance, your product having a hood or sleeve does not cancel out our patent on the outward facing internal clip. There is also no question that our patent was indeed filed before your patent filing.

Tri-Star has invested a great deal of time and effort into the development and implementation of this unique contact design. I am sure you can understand our intent to protect our investment and patent to the fullest extent allowed by U.S. and international patent laws.

The primary purpose of this letter is twofold. First, I want to advise you that your product most definitely violates our patent filings. Secondly, I also wanted to open a dialogue with Preci-Dip so that we could attempt to resolve this issue between our two companies without a lengthy conflict. I would be willing to open a discussion regarding licensing or royalty arrangements prior to other courses of actions. I visit Europe on a regular basis and would be happy to arrange a meeting with you to discuss potential resolutions.

We would like to hear back from Preci-Dip whether you plan to explore these arrangements with Tri-Star or not. My hope is for the two of us to reach a business resolution and move forward.

I will look forward to your response.

Best regards,

David J. Bouzek
VP & Business Unit Manager: Contacts

cc: John Carson, Fulbright & Jaworski, Intellectual Property Attorneys at Law

EXHIBIT F

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June 27, 2008

DB → GM - PL
Page 1/15

Chon Bui
Aero Electric Connector
548 Amapola Avenue
Torrance, CA 90501

Re: Tri-Star Patent Infringement Suit Regarding
Preci-Dip Socket Contacts (MIL C-39029)

Dear Chon,

Tri-Star has invested considerable time and effort in developing and patenting its contact technology. It has come to the attention of Tri-Star that Preci-Dip Durtal SA is manufacturing, importing and distributing a line of electrical socket contacts called Preci-Dip Socket Contacts (MIL C-39029) that Tri-Star believes infringe Tri-Star's U.S. Patent No. 6,250,974. Under U.S. patent laws, anyone who makes, uses, imports, sells, distributes or offers for sale a product covered by a U.S. Patent, without authorization of the patent owner, infringes that patent.

Accordingly, and in order to protect its valuable intellectual property rights, Tri-Star, on June 26, 2008, filed a suit in United States District Court for the Central District of California against Preci-Dip for infringement of Tri-Star's U.S. Patent No. 6,250,974.

Enclosed is a copy of the U.S. District Court Complaint and the attached Tri-Star Contact patent for your review and evaluation in connection with your sale of products manufactured by Preci-Dip.

Please direct any questions you might have to David Bouzek, Tri-Star V.P. & Business Unit Manager, by telephone at 310-536-1313 or by email at david.bouzek@tri-starelectronics.com.

Enclosure: U.S. District Court Complaint
Tri-Star Contact Patent

Best regards,

David J. Bouzek

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Attorneys for Plaintiff
TRI-STAR ELECTRONICS
INTERNATIONAL, INC.

IN THE UNITED STATES DISTRICT COURT

FOR THE CENTRAL DISTRICT OF CALIFORNIA

CV08-04226 GAF AJWx

TRI-STAR ELECTRONICS INTERNATIONAL, INC., a Delaware corporation,

Plaintiff,

v.

PRECI-DIP DURTAL SA, a Swiss corporation,

Defendant.

Civil Action No.

COMPLAINT FOR PATENT INFRINGEMENT

DEMAND FOR JURY TRIAL

Plaintiff Tri-Star Electronics International, Inc., formerly known as TSEI Delaware Two, Inc. ("Tri-Star"), by its attorneys and for its complaint against Defendant Preci-Dip Durtal SA ("Preci-Dip"), alleges as follows:

NATURE OF THE ACTION

1. This is a patent infringement action to stop Preci-Dip from infringement of United States Patent No. 6,250,974 (the "'974 Patent"), entitled HOODLESS ELECTRICAL SOCKET CONTACT, by inter alia, making, using, selling, importing, and/or offering for sale including but not limited to electrical socket contacts, which includes but is not limited to the product designated as MIL-C-39029 ("Preci-Dip Socket Contact Products"). The '974 patent was duly and legally issued on June 26, 2001, after full and fair examination by the United States Patent and Trademark Office. A true and correct copy of the '974 Patent is attached hereto as Exhibit A. The '974 Patent has been duly and legally assigned to Tri-Star, which is now (and at all relevant times has been) the owner and possessor of all rights pertaining to the '974 Patent.

PARTIES

2. Plaintiff Tri-Star is a corporation duly organized and existing under the laws of the State of Delaware and is the successor by merger to Tri-Star Electronics International, Inc., a California corporation.

3. Upon information and belief, Defendant Preci-Dip is a Swiss corporation having its headquarters and principal place of business at Rue Saint-Maurice 34, P.O. Box 834, CH-2800 Delémont, Switzerland. Preci-Dip conducts business on a regular basis in the State of California.

JURISDICTION AND VENUE

4. This Court has subject matter jurisdiction over this action pursuant to 28 U.S.C. §§ 1331 and 1338(a) because it arises under the patent laws of the United States, including 35 U.S.C. §§ 271 et seq.

5. This Court has personal jurisdiction over Preci-Dip because Tri-Star is informed and believes that Preci-Dip has established minimum contacts with the forum such that the exercise of jurisdiction over Preci-Dip would not offend traditional notions of fair play and substantial justice. Preci-Dip has established these minimum contacts by conducting business on a regular basis within the State of California and this district, and purposely placing infringing products into the stream of commerce with the expectation they will be purchased and used by consumers in California, including this district.

6. Venue is proper in this Court pursuant to 28 U.S.C. §§ 1391(b), 1391(c) and 1400(b) because Preci-Dip has committed acts of infringement in this district and division and has sold the infringing products in this district and division.

COUNT 1

INFRINGEMENT OF U.S. PATENT NO. 6,250,974

7. Plaintiff incorporates by reference paragraphs 1 through 6, the same as if set forth at length.

8. Upon information and belief, Preci-Dip has directly infringed and continues to infringe directly or under the doctrine of equivalents, by making, using, selling, providing, importing and offering to sell (directly or through intermediaries) Preci-Dip Socket Contact Products in this district and throughout the United States.

9. Upon information and belief, Preci-Dip has contributed to the infringement of the '974 patent, and/or actively induced others to infringe (directly or under the doctrine of equivalents) the '974 patent in this District and elsewhere in the United States and its territories.

10. Preci-Dip's acts of infringement have caused damage to Tri-Star, and Tri-Star is entitled to recover from Preci-Dip the damages sustained by Tri-Star as a result of Preci-Dip's individual wrongful acts in an amount subject to proof at trial.

11. Preci-Dip's infringement of Tri-Star's exclusive rights under the '974 Patent will continue to damage Tri-Star's business, causing irreparable harm, for which there is no adequate remedy at law, unless Preci-Dip is enjoined by this Court.

12. Upon information and belief, Preci-Dip's infringement of the '974 Patent is willful and deliberate, entitling Tri-Star to increased damages under 35 U.S.C. § 284 and to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

PRAYER

WHEREFORE, Tri-Star prays for the following relief:

1. For judgment that the '974 Patent has been infringed by Preci-Dip;

2. For an accounting of all damages sustained by Tri-Star as the result of the acts of infringement by Preci-Dip;

3. For preliminary and permanent injunctions enjoining the aforesaid acts of infringement by Preci-Dip, its officers, agents, servants, employees, all parent and subsidiary corporations and affiliates, its assigns and successors in interest, and those persons in active concert or participation with any of them who receive notice of the injunction, enjoining them from continuing acts of infringement of the '974 Patent, including, without limitation, from continuing to make, sell, offer for sale, import, or use Preci-Dip Socket Contact Products.

4. For actual damages together with prejudgment interest;

5. For enhanced damages pursuant to 35 U.S.C. § 284;

6. For an award of attorneys' fees pursuant to 35 U.S.C. § 285 or as otherwise permitted by law;

7. For all costs of suit; and

8. For such other relief as the Court may deem just and proper.

DEMAND FOR JURY TRIAL

Pursuant to Federal Rule of Civil Procedure, Rule 38, Tri-Star demands a trial by jury.

Dated: June 26, 2008

GREGORY B. WOOD
TODD M. SORRELL
SPENCER PERSSON
FULBRIGHT & JAWORSKI L.L.P.

By _____
GREGORY B. WOOD
Attorneys for Plaintiff
TRI-STAR ELECTRONICS INTERNATIONAL

US006250974B1

(12) United States Patent
Kerek

(10) Patent No.: US 6,250,974 B1
(45) Date of Patent: Jun. 26, 2001

(54) HOODLESS ELECTRICAL SOCKET CONTACT

(75) Inventor: Leslie Laszlo Kerek, Los Angeles, CA (US)

(73) Assignee: Tri-Star Electronics International, Inc., El Segundo, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/395,518

(22) Filed: Sep. 14, 1999

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/104,733, filed on Jun. 25, 1998, now abandoned.

(51) Int. Cl.[7] H01R 13/187
(52) U.S. Cl. 439/843
(58) Field of Search 439/843, 851, 439/856, 845

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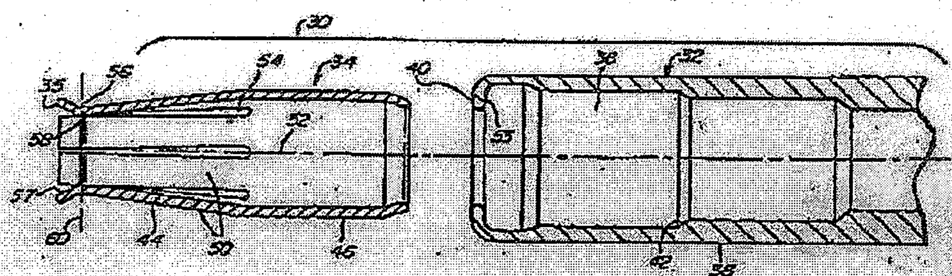
* cited by examiner

Primary Examiner—Brian Sircus
Assistant Examiner—Javaid Nasri
(74) Attorney, Agent, or Firm—Harold L. Jackson

(57) ABSTRACT

A connector terminal is disclosed including a cylindrical socket body with a spring contact inserted therein. The spring contact has a distal portion that establishes a press fit with the socket body. The socket body may be crimped over the distal portion to more securely hold the spring contact in the socket body. The spring contact further has a plurality of fingers which taper forwardly and inwardly to resiliently grab a male pin as it enters the socket.

20 Claims, 5 Drawing Sheets



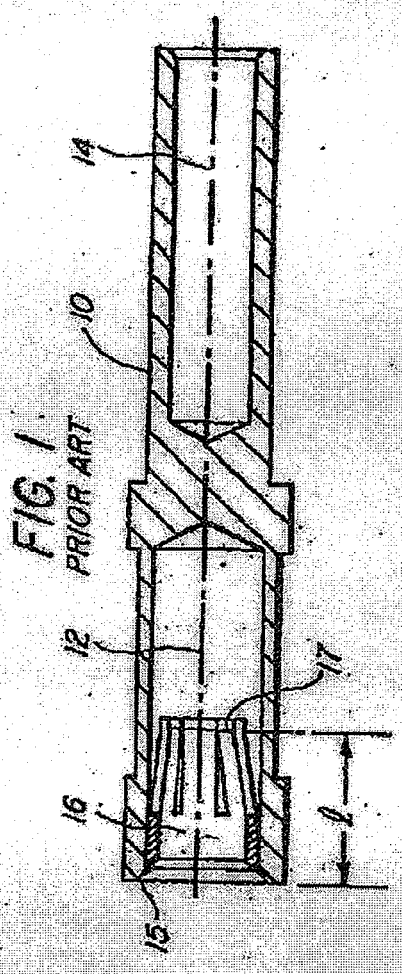


FIG. 1
PRIOR ART

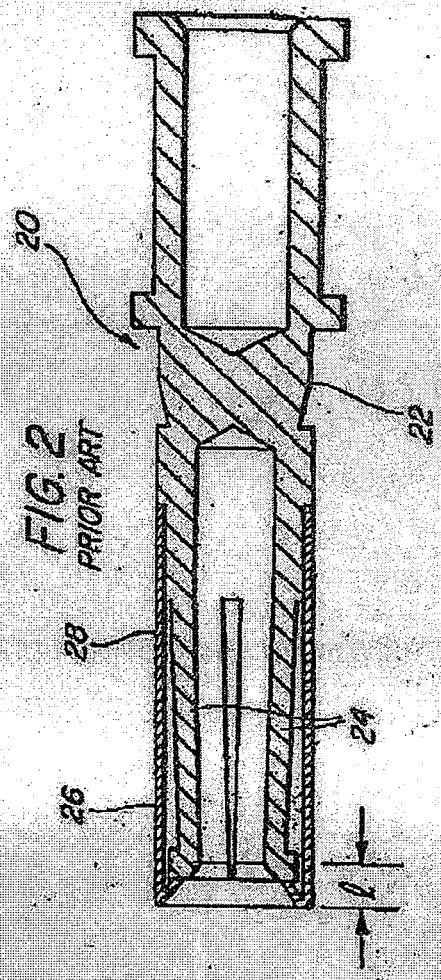


FIG. 2
PRIOR ART

FIG. 3

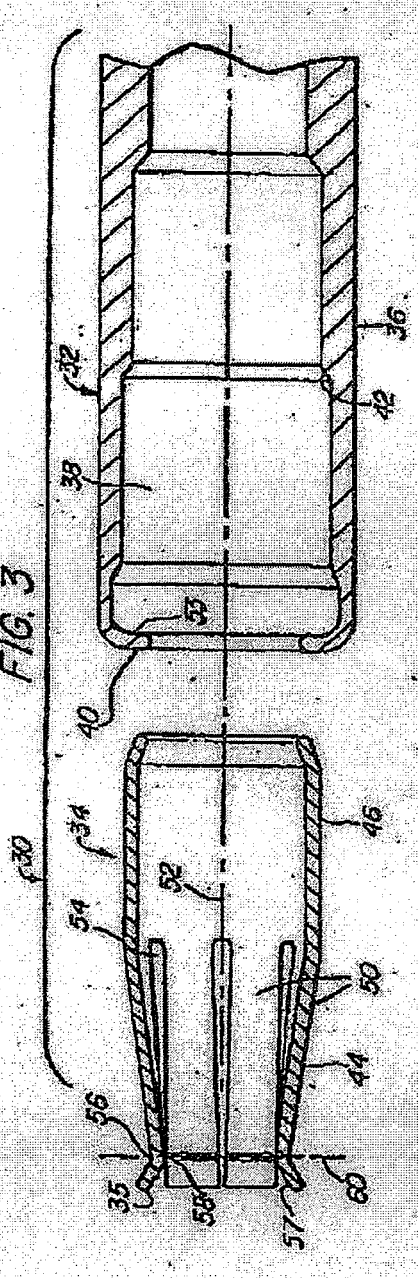

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FIG. 4

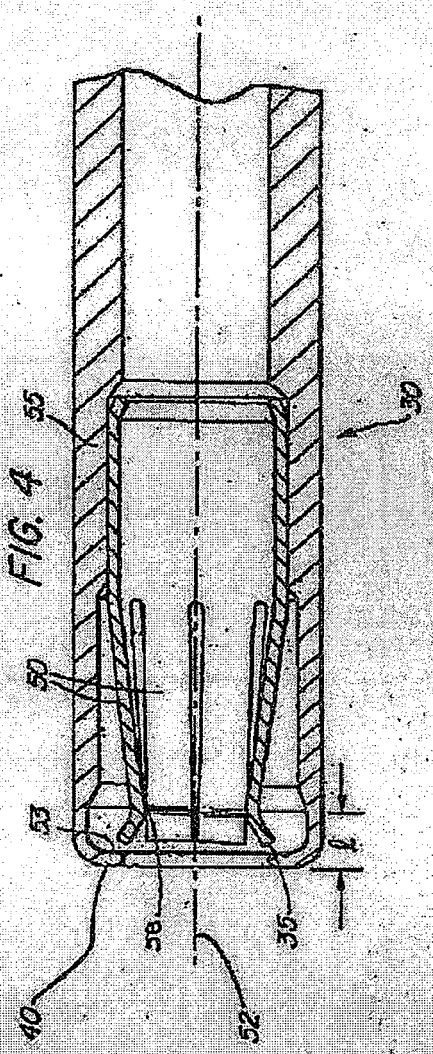
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FIG. 5

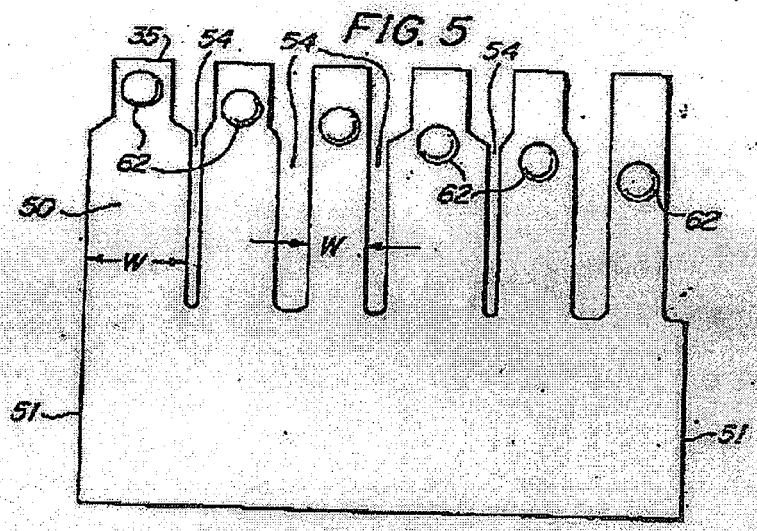


FIG. 6A

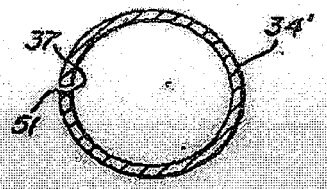


FIG. 6B

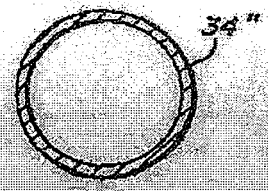
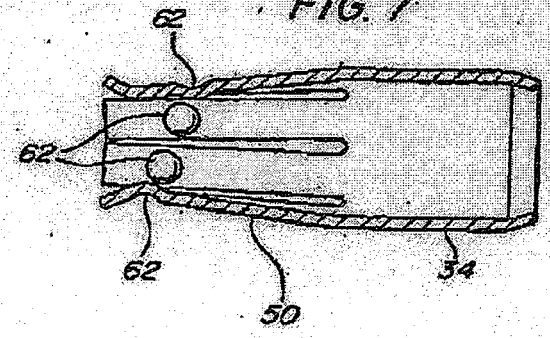


FIG. 7



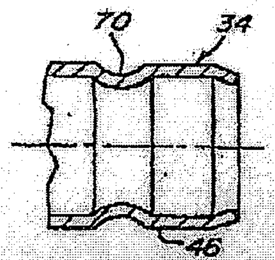


FIG. 8A

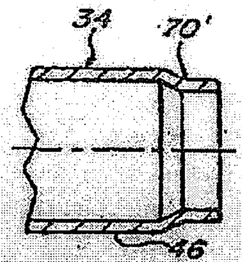


FIG. 8B

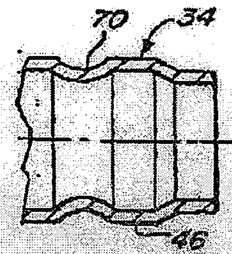


FIG. 8C

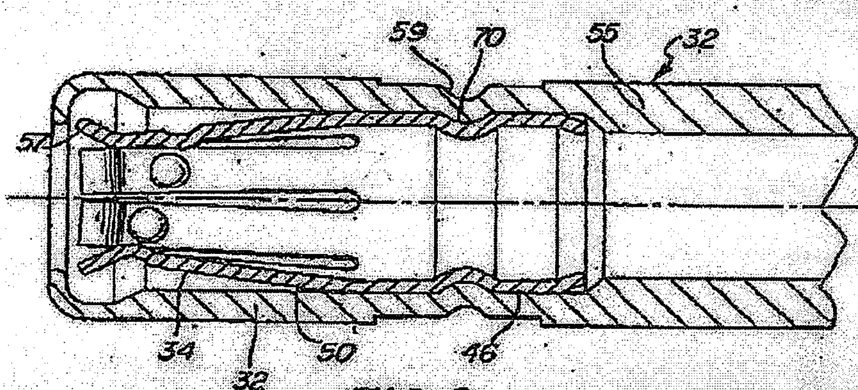


FIG. 9

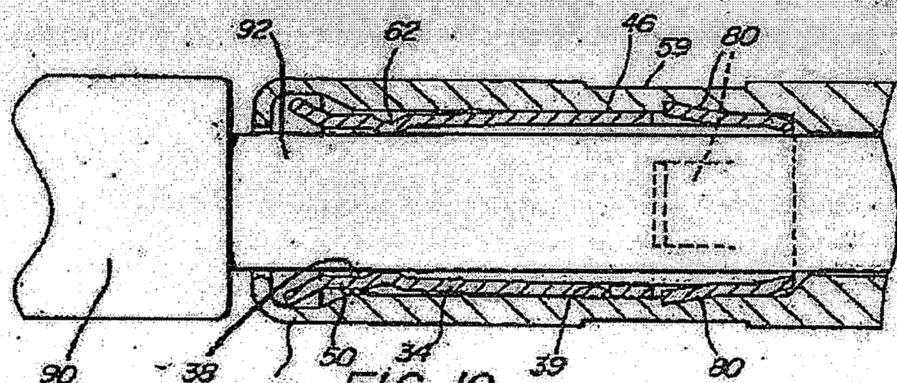


FIG. 10

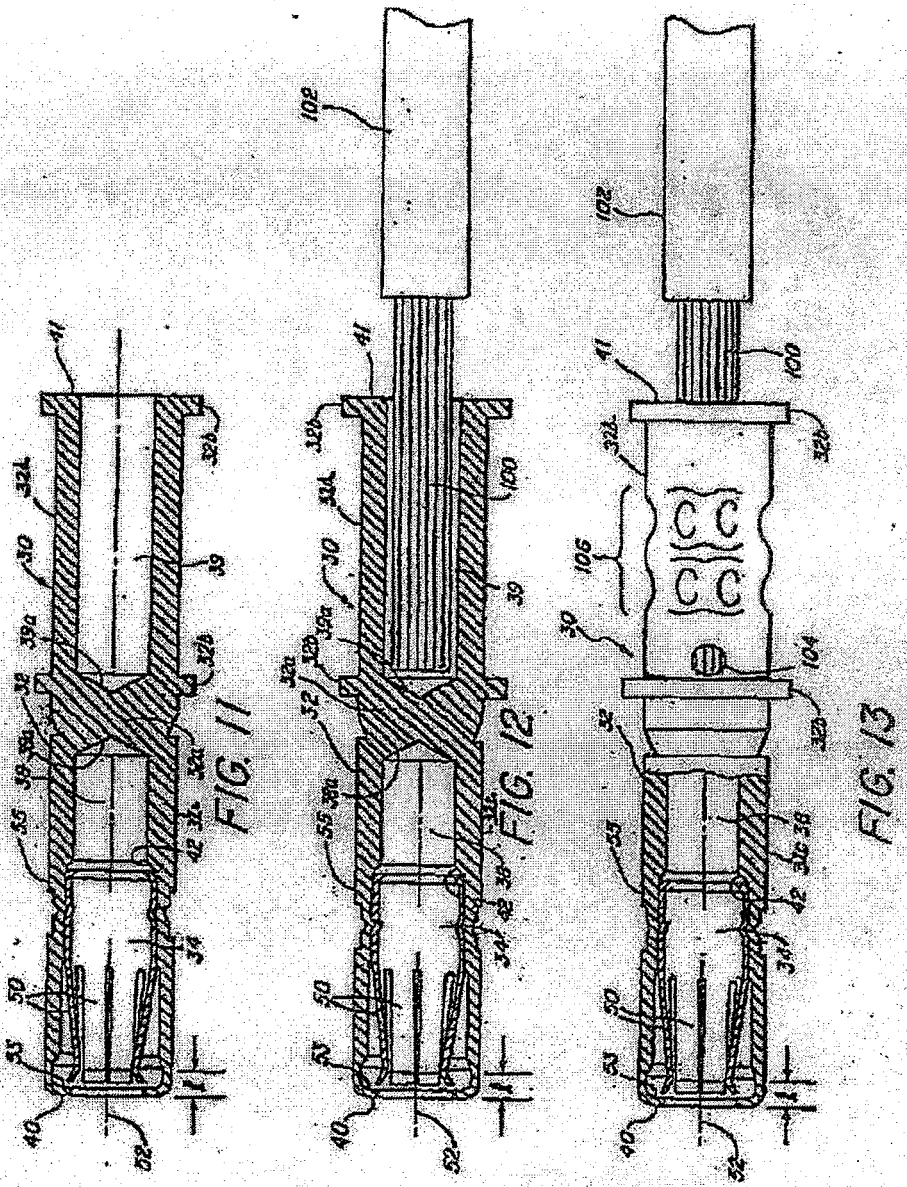


FIG. 11

FIG. 12

FIG. 13

HOODLESS ELECTRICAL SOCKET CONTACT

RELATED APPLICATION

This application is a continuation-in-part of my application Ser. No. 09/104,733 filed Jun. 25, 1998 entitled Hoodless Electrical Socket Connector which was abandoned on Feb. 4, 2000.

FIELD OF THE INVENTION

This invention relates generally to electrical contacts, and more particularly, it is directed to a hoodless socket contact and method for making the same.

BACKGROUND OF THE INVENTION

Electrical contacts are present in all avionics, military and aerospace equipment environment such as in helicopters, missiles and planes. Such equipment may have dozens or even hundreds or even thousands of electrical connections that must be made between electronic power supplies, sensors, activators, circuit boards, bus wiring, wiring harnesses, to provide the electrical pathways or highways needed to transport electricity in the form of control signals and power. The hardware reliability requirements for operating in an avionics environment are stringent as a failure can have catastrophic consequences. As such, the electrical components and circuitry, as well as the connectors and contacts therein employed to electrically connect these items, must work in a wide range and wide variety of environmental conditions such as mechanical, vibration, wide temperature ranges, humidity and corrosive elements, etc. For example, military standards (also known in the industry as mil specs) for aircraft avionics equipment require that contacts be able to mate and unmate a minimum of five hundred times without a failure during all anticipated environmental and mechanical conditions. In addition, the contact assemblies must be protected to withstand repeated handling without significant distortion or damage to the interconnecting parts which could lead to a lack of electrical continuity.

One example of a high-amperage power socket contact or terminal is illustrated in U.S. Pat. No. 5,376,012 "Power Port Terminal" to Clark which includes a contact socket receiving portion and an integral mounting portion. The socket includes a web with a plurality of beams therein. Each of the beams has a curved surface with a bend, which beams cooperate to form an axially extending tubular socket region which accepts a pin terminal of any desired length. Disadvantageously, the beams are exposed and therefore subject to damage. Additionally, the beams of the socket contact are not protected from entry of an oversize male contact, which may bend the beams beyond their elastic limit thereby damage the connector so that it will not perform electrically.

Another example of a socket contact is illustrated in U.S. Pat. No. 4,906,212 entitled "Electrical Pin and Socket Connector" to Mixon, Jr. which includes a socket have a cylindrical mating portion defined by cantilever beams having one or more blades wherein one or more of the blades include a rearwardly extending free end. The pin includes a mating portion having a bullet nose at one end and a wire barrel at another end. This connector suffers from the same limitations as the Clark connector and therefore is an undesirable alternative in environments where high reliability is critical.

A prior art female contact which is used in non-critical and in non-aerospace applications is shown in FIG. 1 which contact includes a cylindrical member 10 having holes 12 and 14 in the ends thereof. A spring member 16 is inserted in one of the ends, the spring member tapering rearwardly into the hole 12. Accordingly, a male pin contact inserted into the cylindrical member 10 would be grasped by the spring member 16 relatively deeply within the hole 12 which is disadvantageous. The distance from the free end 15 of the socket to the point of engagement 17 with a male contact or pin is designated by the letter "l" in FIG. 1 (and in FIG. 2). The particular connector halves in which the male and female contacts are used (and the positioning of the connector halves on the equipment, e.g., mays and black boxes) may result in a lesser or greater penetration of the male pins into the socket body. Furthermore, there is no mechanical structure to ensure that the spring member 16 will remain in place, and as such the spring may "walk out" of the hole during vibration or during mating and unmating cycles. Mil specs require that a spring member which provides the electrical continuity must be able to withstand the separation forces during the mating cycle (i.e., 500) without being dislodged under all anticipated environmental conditions including vibration. The arrangement of the spring 16 socket member 10 could be potentially hazardous if used in avionics environments where high reliability is a must for human safety.

Another example of a socket contact that is successfully manufactured and sold by the assignee of the present invention is shown in FIG. 2. This contact 20, sometimes referred to as a hooded socket contact, includes a tubular socket body 22 having a plurality of tines 24 for receiving a male contact or pin. A hood 26 is inserted over the tines 24 and rear portion of a contact to protect the tines from damage. The hood is generally made of stainless steel with a wall thickness of only 0.004 to 0.010" for economic and reliability reasons. The hood is press fit over the cylindrical shoulder portion 28 at the rear of the contact. This press fit arrangement, due to the hood's wall thickness, requires precision manufacturing. Improper sizing of the socket body shoulder may result in damage to the hood during the press fit operation or the hood may come loose during use. Plating of the contact may exacerbate the press fit step during manufacturing. Furthermore, a stainless steel hood may not be tolerated in certain applications where interference with magnetic fields is a problem. In summary, the manufacturing steps necessary to insure reliable performance of the hooded type contact shown in FIG. 2 may result in a fairly expensive contact when mass produced.

Accordingly, there is a need for an improved socket contact that is simple to manufacture yet reliable in performance and that can be made in mass quantities at relatively low cost.

SUMMARY OF THE INVENTION

The foregoing mentioned disadvantages are avoided by providing a hoodless socket or female contact for engaging a male pin contact. The female contact includes a socket body with two ends, each end having an axially oriented hole or bore. A spring for making an electrical connection with a male contact or pin is located in one of the holes. The spring is arranged for resiliently engaging the male pin contact in close proximity to the hole entry point or free end of the socket body. Means are provided for securely holding the spring in the hole, which may be established by a press fit of the spring within the hole coupled with an extension of the socket body overlaying a portion of the spring thereby preventing the spring from exiting from the socket body.

Alternatively, the spring may be securely coupled in the socket body by crimping the socket body onto the spring. Preferably, this is achieved by crimping a portion of the socket body into a peripheral annular groove in the spring. Barbs on the spring, which engage the inner wall of the hole of the socket body, may also be employed, with or without crimping, to provide additional security.

The hole at the other end of the socket body is sized and shaped to receive a conductor such as a insulated copper wire. The conductor may be electrically and mechanically secured together with the socket body by crimping the socket body onto the conductor.

The construction and operation of preferred embodiments of the contact of the present invention may best be understood by reference to the following description taken in conjunction with the accompanying drawings in which like components or features are designated by the same or primed reference numbers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side cross-sectional view of a prior art contact;

FIG. 2 is a side cross-sectional view of another prior art contact;

FIG. 3 is a side cross-sectional, partially broken away side view of a socket contact in accordance with the principles of the invention illustrating the two parts of the socket contact prior to assembly;

FIG. 4 is a side cross-sectional, partially broken away side view of the contact parts of FIG. 3 assembled together;

FIG. 5 is a side view of a stamped out spring prior to roll forming;

FIGS. 6A and B are cross-sectional views illustrating a spring made from roll forming ("seam type") or deep drawn ("seamless type") processes, respectively;

FIG. 7 is a side cross-sectional view of the spring with dimples;

FIGS. 8A–C are partial side cross-sectional views of the back end of the spring with optional groove configurations thereon;

FIG. 9 is a cross-sectional side view of an assembled socket contact that has been crimped;

FIG. 10 is a cross-sectional view of another assembled socket contact wherein the two parts are assembled together and is additional are also retained by barbs and a pin terminal is inserted into the socket contact;

FIG. 11 is a cross-sectional side view illustrating the two parts of the socket contact prior to assembly with an electrical conductor;

FIG. 12 is a cross-sectional side view of the socket contact with metal strands of an insulated conductor wire inserted into the rear portion of the socket body prior to crimping, and

FIG. 13 is a partially broken away side view of the socket contact with the rear portion of the socket body crimped onto the wire strands.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and more particularly to FIGS. 3 and 4, there is shown a socket contact generally indicated by reference number 30. The socket contact, sometimes hereinafter referred to as a hoodless socket, is made from two parts including a socket body 32 and a spring 34. The socket body 32 consists of a cylindrically or

tubularly shaped member 36 having two ends, with an axially disposed male-contact-receiving hole or bore 38 extending from one of the ends 40 (i.e., free end) into the socket body a preselected distance and a conductor or wire receiving hole of bore 39 at the other end 41 thereof. See FIG. 11. The socket body 32 may be made of an electrically conductive material such as a brass/copper alloy. The male-contact-receiving hole 38 may have an inwardly projecting shoulder 42 that provides a back stop for the seating of the spring 34.

The spring 34 contains a forward male contact receiving portion 44 and a rear mounting portion 46. The contact receiving portion 44 includes a plurality of fingers or tines 50. The fingers are arranged around the longitudinal axis 52 of the spring 34 and are separated by gaps or slots 54 between adjacent fingers. Each of the forwardly extending fingers tapers inwardly to define together a tubularly shaped contact region 56 and 58 which engages a male pin inserted 3 therebetween and to provide a reliable electrical connection therebetween under anticipated adverse conditions. The portion of the fingers forward of the contact region 56 bend outwardly to form a flared region 57 which acts as a centralizer for guiding the insertion of a male pin. The tubularly shaped contact region 56 at the bends define a plane curved contact surface which surface may be in radial, place such as the an annular contact surface 58 at a preselected point 60 along a longitudinal axis 52. The preselected point for annular contact surface 58 of the spring 34 is spaced within about 0.020 to 0.045 inches, and preferably about 0.035 inches maximum, from the free end 40 of the socket body when the spring contact is secured therewith, i.e., equals about 0.020" to 0.045" and preferably about 0.035" maximum. The distance from the free end 40 of the socket body to the annular contact surface 58 is designated by the letter " " in FIG. 4. The aforedescribed arrangement between the socket body and spring thus allows electrical contact to be made with a male contact close to the end 40 of the socket body. This advantageously provides electrical contact to be made immediately coaxially upon coupling a male contact (not shown) to the hoodless female contact 30, as required by the applicable mil specs.

The spring 34' may be of the seam type in which case it is made in a flat configuration, as illustrated in FIG. 5, and then roll formed into the form of a sleeve. A small gap 37 is formed between the edges 51, as shown in FIG. 6A. This gap may visually disappear as a result of the roll formation and press fit steps. Alternatively, the spring 34' may be of the seamless type made, for example, by deep drawing process well known in the art, as shown in FIG. 6B.

While the fingers 50 described hereinabove provide good electrical continuity to a male terminal, increased electrical contact may be established by providing the contact region 56 with inwardly disposed dimples 62, as shown in FIG. 7. While the dimples could be disposed on the same radial plane, preferably the dimples 62 are staggered on the fingers 50, i.e., disposed at different axial distances from the free end of the socket body as shown more particularly in FIG. 5. This advantageously reduces the insertion force needed to insert a male pin between the fingers 50 than when the dimples 62 are all on the same radial plane, while increasing the retention force provided by the fingers 50. Additionally, by staggering the dimples 62, the resonance point of the individual fingers 50 will vary during vibration, thus mitigating open circuit faults. Fingers having different widths "W", as illustrated in FIG. 5, also aid in overcoming the resonance problem encountered with conventional spring contacts. The dimples 62 further assure that a gas-tight

connection is established between the fingers and a male contact. Such a gas-tight connection seals out corrosive gases and thereby prevents formation of films or corrosives on the surfaces interconnecting the mating male/female contacts that could degrade the electrical conductivity therebetween and cause failures in the connection. It should be noted that dimples or fingers having differing widths may not be necessary in many applications.

The spring 34 may be retained within the hole 38 of the socket body 32 by inserting the contact into the socket body with a press fit configuration and thereafter rolling the free end of the socket body radially inwardly to form an annular shoulder 53 which will engage end 35 of the spring in the event that a sufficient force is applied to the spring tending to pull the spring out of the socket body. See FIG. 6. Alternatively, or in addition thereto, the rear mounting portion 46 of the spring contact may have an annular groove 70 therein, shown with more particularity in FIG. 8A. After assembly, the wall of the socket body 32 may be roll crimped such that a portion 59 of the socket body wall is rolled into the groove 70, as shown in FIG. 9. The rear mounting portion 46 of the spring 34 may have a variety of groove configurations, as shown with more particularity in FIGS. 8A–C.

Another means for retaining the spring in the socket body is shown in FIG. 10. In this embodiment, the rear mounting portion 46 of the spring has a plurality of outwardly extending spring retention barbs 80. The barbs 80 resiliently compress inward upon insertion of the spring 34 into the hole 38, but dig into the inner wall 38 of the hole to resist removal. As further illustrated in FIG. 10, the pin portion 92 of a male contact 90 is inserted between fingers 50 which spread to resiliently grasp the pin portion 92 via the dimples 62. It should be noted that the dimples 62 are optional.

FIGS. 11–13 illustrate an attachment mechanism for electrically connecting the socket body 32 to an electrical conductor 102, such as a conventional insulated copper wire, for example. The socket body 32 includes a forward (first) tubular portion 32c and a rearward (second) tubular portion 32d separated by a solid center section 32a. The second or rearward portion 32c forms a wire receiving end 41 which opens to a rear hole or blind bore 39 which receives the copper strands 100 of insulated wire 102. The first or forward tubular portion 32c includes the male contact receiving blind bore 38 discussed previously. The front and rear bores 38 and 39 are closed by end walls 38a and 39a, respectively, formed by center section 32a of the socket body. The socket body 32 includes a pair of spaced radially extending shoulders 32b.

As is shown in FIG. 12, the wire strands 100 of the conductor 100 are inserted a predetermined distance into hole 39, which insertion may be aided by a small viewing hole 104 (shown in FIG. 13). The distal end wall 39a of the hole 39, in any event, limits the insertion distance of the wire. A selected portion 106 of the socket body 32, extending over the wire strands 100, is crimped onto the wire strands to make good electrical contact therewith and mechanically hold the wire strands 100 in the socket body 32, as shown in FIG. 13. Advantageously, the socket body while serving to hold and protect the spring also provides for direct attachment to conductor wires and the like without the need for additional parts. It should be noted that while it is preferable to provide separate front (first) and rear (second) holes, 38 and 39, respectively, separated by a center section 32a of the socket body, the hole or bore could be continuous, i.e., one long bore.

There has thus been described an improved contact arrangement which can be cost effective manufactured on a repetitive basis. This spring is protected from damage by the socket body. The dimples, when utilized, provide an increased gas tight point(s) of contact, allowing thinner or less noble electrical conductive plating to used on the fingers. Optionally, staggering the dimples reduces the overall mating and unmating force while maintaining a desired gas tight seal between the fingers and the male contact. Accordingly, various modifications of the boodless socket, and processes involved in manufacturing the contact terminal, will occur to persons skilled in the art without involving any departure from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A two piece boodless female contact for engaging a male pin comprising:

a socket body forming one piece of the contact, the socket body having a first tubular portion and a second portion extending along a longitudinal axis, the first portion having an axial hole therein defining an open free male contact receiving end, the second portion having an open wire-receiving end for connection with an electrical conductor; and

a separate spring forming another piece of the contact, the spring being located in the axial hole defining the male contact receiving end of the first tubular portion, the spring including a forward portion and rear portion, the forward portion having a plurality of forwardly and inwardly extending fingers which terminate near the free male contact receiving end of the first tubular portion for resiliently grasping a male pin in close proximity to the free male contact receiving end.

2. The contact defined in claim 1 wherein the socket body further includes a third portion in the form of a solid generally cylindrical section disposed between the first and second portions and wherein each of the fingers includes a male pin engaging surface and wherein the male pin engaging surfaces of the fingers are arranged to grasp the male pin at a distance along the longitudinal axis within a range of about 0.025 to 0.045 inches from the free male contact receiving end of the socket body.

3. The contact defined in claim 2 wherein each of the fingers flare outwardly and forwardly of the respective pin engaging surface thereof for facilitating insertion of the male pin in between the fingers.

4. The contact defined in claim 1 wherein each of the fingers has an inwardly disposed dimple which forms the pin engaging surface for engaging the male pin.

5. The contact defined in claim 4 wherein the dimples are staggered along the lengths of the individual fingers with the dimples being positioned at different axial distances from the free male contact receiving end of the first tubular portion of the socket body.

6. The contact defined in claim 1 wherein the first tubular portion of the socket body is crimped onto the rear portion of the spring.

7. The contact defined in claim 1 wherein the forward portion of the spring terminates axially inwardly of the free male contact receiving end of the first tubular portion of the socket body and wherein the free end of the first tubular portion of the socket body is rolled over to extend radially inwardly beyond the forward portion of the spring to prevent removal of the spring from the hole and to center a mating pin contact.

8. A two piece female contact comprising:

a cylindrically shaped socket body member formed as a single part comprising one piece of the contact, the socket body member having first and second tubular